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HILTON SYSTEMS, INC. REPORT NO.: HSI/89-0013-04/1Z

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**DEFICIENCY REPORT
MANAGEMENT SYSTEM**

FINAL TECHNICAL REPORT

28 SEPTEMBER 1989

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Prepared For: Commander
U.S. Army Missile Command
ATTN: Mr. Thomas L. Moore
Product Assurance Directorate
AMSMI-QA-CF
Redstone Arsenal, AL 35898-5290

The Contractor, Hilton Systems, Inc., hereby certifies that, to the best of its knowledge and belief, the technical data delivered herewith under Contract DAAH01-89-D-0013 is complete, accurate, and complies with all requirements of the contract.

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ABSTRACT

The Customer Feedback Office of the Product Assurance Directorate, MICOM has the mission to manage and analyze data in the Deficiency Reporting System and make recommendations for appropriate actions. This report presents the results of a contract delivery order for support to the CFO performed by the Product Assurance Division of Hilton Systems, Inc.

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1.0 Introduction

The contractor was issued delivery order number 20 as an expansion of delivery order number 5. Delivery Order 5 was concerned with improving the present day-to-day operations of CFO, while the tasks discussed in this report investigate the application of certain additional capabilities.

The contractor was directed to recommend ways of establishing statistical control of the time required to initiate an investigation. In addition, the contractor was to develop a plan for the implementation of a predictive analysis capability within CFO.

The discussion contained in this report is limited to these tasks, i.e. Statistical Process Control and Predictive Analysis. For completeness, the discussion of work directly related to Delivery Order 5 is discussed in the Final Technical Report for that delivery order.

Progress made in meeting these requirements is discussed herein and this report follows the format of data item description, UDI-S-23272C.

2.0 Discussion

2.1 Statistical Process Control

The contractor was directed to analyze the response times associated with completing Quality Deficiency Report (QDR) actions from receipt to closing with the goal to establish statistical process controls. The specific subprocess to be reviewed was the time required to initiate an investigation on a QDR.

The analysis started with a review of all the pertinent regulations and PAD draft SOP No. 702-QA-1, Processing of Quality Deficiency Reports (QDRs). A number of specific time periods were stated in the documents reviewed, but none set a limit for when an investigation letter had to be completed. There was mention of a 1984 PAD SOP that stated this time to be NLT 7 days after receipt of a QDR, but the analyst was unable to verify this.

With this background, statistical control charts were developed by system and by action officer for the first six months of FY89. This provided a snapshot look at the time it now takes for the needed investigations to be initiated. This established a bench mark from which the PAD managers can make a decision as to what limit, if any, they wish to set.

The following action processing codes were selected as being those that initiate an investigation of some sort:

A - Transferred to a new screening point within the Army

M - Action requested from overhaul facility

P - Screen supply system

X - Forwarded to participating component for action

Y - Received from participating component for investigation

2 - Investigation by other than Army

4 - Action requested from Mat_Mgt.

5 - Action requested from Proc_Pdn

6 - Action requested from R&D

7 - Action requested from other local office

8 - Sent exhibit for evaluation

In all cases, the first occurrence of any of the above codes was considered the start of an investigation. For several QDRs there were multiple entries. Appendix A provides 300 data points which were subgrouped into sets of 10 for analysis. For each group of 10 action code days the average and the range were calculated. After each group average and range were determined, overall average and the average of all the ranges were calculated. This provided an estimate of the grand average and average range for the total population of QDRs requiring an investigation action.

Using the Shewhart concept of variation, upper and lower control limits were set at a distance of three standard deviations on either side of the estimated averages. The constants contained in Table 1 below are used to simplify the arithmetic in the following formulas:

$$UCL_{\bar{X}} = \bar{\bar{X}} + A_2 R$$

$$LCL_{\bar{X}} = \bar{\bar{X}} - A_2 R$$

$$UCL_R = D_4 \bar{R}$$

$$LCL_R = D_3 \bar{R}$$

Where:

UCL = Upper Control Limit

LCL = Lower Control Limit

\bar{X} = mean or average of each subgroup of 10 data elements

$\bar{\bar{X}}$ = the average of the 10 group averages

R = range

\bar{R} = the average of the ranges

TABLE 1

**CONTROL CHART CONSTANTS FOR AVERAGE AND RANGE CHARTS
BASED ON THE AVERAGE RANGE**

SUBGROUP SIZE	A ₂	D ₃	D ₄
2	1.880	0	3.268
3	1.023	0	2.574
4	0.729	0	2.282
5	0.577	0	2.114
6	0.483	0	2.004
7	0.419	0.076	1.924
8	0.373	0.136	1.864
9	0.337	0.184	1.816
10	0.308	0.223	1.777

Using a subgroup size of 10 the following values from Table 1 are placed in the above formulas: $A_2 = 0.308$; $D_3 = 0.223$; $D_4 = 1.777$. The average mean (\bar{X}) time to start an investigation at present time was 13.9 days, with a calculated upper limit of 24.5 days and a lower limit of 3.3 days. The average range (R) is 34.3 days, with an upper limit of 60.9 days. As can be seen from Appendix B there were 2 incidents of upper bound violation in mean and 5 incidents in range.

Appendix C is a presentation of the same data from a monthly standpoint. The data points were selected by action process date and placed in subgroups of five within each month. To compensate for the dropping of subgroups of less than five, the month of April was added to the population. In order to provide a month to month comparison, the population average, range and control limits were used to plot the monthly data.

The same procedures discussed above were used with the values for A_2 , D_3 and D_4 taken from the subgroup size 5.

As can be seen on the charts in Appendix C, the average mean is 14 days, with an upper limit of 27.7 days and an average range of 23 days, with an upper limit of 48.6 days. Interesting to note is that by this method, with data regrouped by fives, we now have 4 violations of upper limit in mean (October, December, January, February) and 7 in range (October, November, February) verses the 2 and 5 respectively seen on the chart in Appendix B.

Next we show the data by action officer. The computer was programmed to sort all QDRs by action officer code and subtract the date an investigation code appeared from the received date. This gave the analyst a list of all QDRs by action officer with the number of days required to take action listed (Appendix D). These points were then grouped by five and the charts in Appendix E formulated. The average, range and control limits were computed, as stated earlier, for each action officer. This gave a picture of how consistently each one performed.

Table 2 is a matrix of all action officers and the population depicting how each performs individually against the group averages. These numbers demonstrated one possible method that a manager could use in evaluating the performance of his organization both collectively and individually.

TABLE 2
CONTROL CHART DATA COMPARISON

POPULATION ACTION OFFICER	TOTAL # QDRS	\bar{X}	UCL(X)	R	UCL(R)
	352	14	27.7	23	48.6
GSR	145	12.8	20.0	12.5	26.4
JC	60	29.0	57.8	50.0	105.7
LMB	95	9.2	22.0	22.0	48.0
SEW	40	9.9	18.0	14.0	29.0
SJS	12	15.6	20.0	4.0	10.0

All the above is for demonstration of principle purposes. The data used was taken from a prior, 11 August 1989, download of data from the Information Management Directorate (IMD) and is only representative of the total QDR database.

2.2 Predictive Analysis

The ability to predict what will happen, with a high degree of accuracy, to a weapon system or repair part once it has been fielded has long been the goal of development and support personnel. Predictive analysis techniques were examined for the purpose of providing such a capability within PAD.

The plan attached at Appendix F presents a sequential methodology to achieve this goal. The following paragraphs provide a discussion of a system being implemented at TACOM. This system, with modification, may have application for MICOM and moves the process to step 3 of the proposed plan.

The Fielded Vehicle Performance Data System (FVPDS) integrates data from a number of sources into a single database and is being evaluated for use as a possible AMC standard system. The program runs on a mainframe computer and requires 5.7 gigabytes of direct access storage. The data management program used by FVPDS is an AMC system called Model 204, which is also being considered as an AMC standard. FVPDS contains 2 years of historical data which may or may not be acceptable to MICOM. It has been designed to use the source systems data as it comes in and to make comparisons for trend and predictive analysis purposes.

TACOM plans include the establishment of a functional control group of 6 personnel to control, operate and maintain the system as well as the equivalent of 2.6 personnel at installation level to maintain and operate the mainframe portion. This is a total of 8.6 full time personnel for FVPDS.

The system is menu driven, considered user friendly and simple to use. It has four levels of access security so that users will only be able to access that for which they have a need. Access control will be maintained by the functional control group. Working access is desired for all personnel of TACOM and this is a matter of availability of funds for terminals and training. This wide dissemination is possible since FVPDS contains unclassified information. There are a number of cross references available which make it easy to obtain the whole picture on a stated problem. The system produces a number of standard reports which may be viewed on the screen and/or printed. Tailored reports may also be produced for special purposes. Tailoring may be done by the user, as can query, for matting and running.

The benefits of FVPDS, as seen by TACOM, are that it will help people at TACOM solve business problems faster and at less cost and will provide 1% to 2% discretionary hours that could be used more creatively to benefit the command.

The intangible benefits that could be derived from FVPDS as stated by TACOM are listed below:

Greater Preparedness
Greater Trust in TACOM
More Confident Soldiers
Higher Quality Work
Better Educated Workers
Better Vehicle Designs

Proactive Influence on Fielded System

Designed by TACOMers for TACOMers and transportability to the other MSCs

3.0 Status of Accomplishments

3.1 Statistical Process Control

As stated in the discussion, initiation of an investigation was examined for the whole process and also by action officer. These results are preliminary and now await PAD management review for a determination as to what the next step will be.

3.2 Predictive Analysis Plan

The plan has been released to PAD and preliminary analysis of the TACOM Fielded Vehicle Performance Data System (FVPDS) completed. This task is also waiting management review and guidance.

4.0 Summary

4.1 The automation of statistical process control on the QDR processing actions appears to be possible within the UNIX system as it exists. A review of available commercial software may reveal a product that meets PAD's requirements and saves programming time. For initiation of investigation a decision is required as to what the acceptable limits are and these need to be made known to the personnel doing the work. They must also be made aware of the mechanics of the SPC process as to what is being measured and how and the purpose for the measurement must be fully understood and agreed upon by all personnel, management and worker.

4.2 The predictive analysis plan presented to PAD outlines a zero base start to achieve that capability. The start of the initial review of available systems turned up the TACOM FVPDS, which appears to be a viable candidate for modification and adoption by MICOM. FVPDS is considered viable because it is written around a proposed AMC standard database management system that will allow the application of command unique routines and it uses several sources mentioned in the plan submitted. A closer look at the TACOM product is warranted and close coordination with Mr. John McGowen, MLC, 876-9018, the MICOM POC for FVPDS is required.

5.0 Recommendations

5.1 Since presentation of data is a big portion of the PAD requirements and the Sperry is somewhat limited in its graphics capability, it is recommended that commercial SPC software packages be reviewed for a possible fit. At a minimum, PAD management must set time limits for those items they desire to measure that are not now set by regulation. The personnel performing the actions being measured must be made aware of what is being measured, how it's being measured and why its being measured and should be a part of the goal setting process.

5.2 It is recommended that a much more detailed look at the TACOM FVPDS be completed before any decision on pursuing a unique MICOM program be made. Particular attention must be paid to hardware requirements and MICOM management desires versus FVPDS products.

APPENDIX A
DATA SORT BY DMN

<u>C1</u>	<u>C50</u>	<u>C20</u>	<u>C3</u>	<u>C5</u>	<u>C202</u>	<u>C203</u>	<u>ACT PROC D</u>
P18L00752	LMB	EF	19881005	19881114	A	19881114	11
P18L00753	LMB	EF	19881005	19881005	2	19881103	29
P18L00753	LMB	EF	19881005	19881005	V	19890208	
P18L00753	LMB	EF	19881005	19881005	9	19890209	
P18L00754	SEW	FG	19881005	19881212	2-	19881019	11
P18L00754	SEW	FG	19881005	19881212	B	19881212	
P18L00755	SEW	FG	19881005	19881212	2-	19881019	11
P18L00755	SEW	FG	19881005	19881212	B	19881212	
P18L00756	SEW	FG	19881005	19881212	2-	19881019	11
P18L00756	SEW	FG	19881005	19881212	B	19881212	
P18L00757	SEW	FG	19881005	19881212	2-	19881019	11
P18L00757	SEW	FG	19881005	19881212	B	19881212	
P18L00758	SEW	FG	19881005	19881212	2-	19881019	11
P18L00758	SEW	FG	19881005	19881212	B	19881212	
P18L00759	SEW	FG	19881005	19881212	2-	19881019	11
P18L00759	SEW	FG	19881005	19881212	B	19881212	
P18L00760	SEW	FG	19881005	19881212	A	19881006	
P18L00760	SEW	FG	19881005	19881212	R	19881007	
P18L00760	SEW	FG	19881005	19881212	2-	19881019	11
P18L00760	SEW	FG	19881005	19881212	B	19881212	
P18L00761	GSR	DS	19881005	19890102	3	19890102	
P18L00762	GSR	DS	19881005	19890227	2-	19881011	9
P18L00762	GSR	DS	19881005	19890227	C	19881114	
P18L00762	GSR	DS	19881005	19890227	B	19890227	
P18L00762	GSR	DS	19881005	19890227	9	19890109	
P18L00763	GSR	DS	19881005	19890217	2-	19881019	11
P18L00763	GSR	DS	19881005	19890217	P	19881025	
P18L00763	GSR	DS	19881005	19890217	9	19890109	
P18L00763	GSR	DS	19881005	19890217	B	19890217	
P18L00764	GSR	DS	19881005	19890217	2-	19881019	11
P18L00764	GSR	DS	19881005	19890217	9	19890109	
P18L00764	GSR	DS	19881005	19890217	B	19890217	
P18L00765	GSR	DS	19881005	19890217	9	19890109	
P18L00765	GSR	DS	19881005	19890217	2-	19881019	11
P18L00765	GSR	DS	19881005	19890217	B	19890217	
P18L00766	LMB	E2	19881012	19881129	B	19881129	
P18L00767	GSR	DS	19881012	19890301	X-	19881021	9
P18L00767	GSR	DS	19881012	19890301	B	19890301	
P18L00768	JC	E3	19881012	19881012	2-	19881118	37
P18L00769	LMB	E2	19881012	19881012	X-	19881026	14
P18L00769	LMB	E2	19881012	19881012	U	19881223	
P18L00771	LMB	EF	19881012	19890405	2-	19881017	5
P18L00771	LMB	EF	19881012	19890405	9	19890321	
P18L00771	LMB	EF	19881012	19890405	B	19890405	
P18L00772	GSR	D6	19881012	19881012	2-	19881017	5
P18L00772	GSR	D6	19881012	19881012	9	19890118	
P18L00773	GSR	DS	19881013	19881013	2-	19881017	4
P18L00773	GSR	DS	19881013	19881013	9	19890101	
P18L00773	GSR	DS	19881013	19881013	C	19890301	
P18L00773	GSR	DS	19881013	19881013	9	19890321	
P18L00774	SEW	E5	19881013	19881212	X-	19881025	12
P18L00774	SEW	E5	19881013	19881212	U	19881114	
P18L00774	SEW	E5	19881013	19881212	B	19881212	
P18L00775	LMB	F4	19881013	19881013	2-	19881027	14
P18L00775	LMB	F4	19881013	19881013	C	19881221	
P18L00775	LMB	F4	19881013	19881013	9	19890321	
P18L00776	LMB	F4	19881013	19881121	3	19881121	
P18L00777	JC	DC	19881013	19881109	A-	19881109	27
P18L00779	JC	DR	19881013	19881219	A	19881219	67

'18L00780	JC	DC	19881017	19881017	7	19890321	155
'18L00781	SJS	EN	19881017	19881017	C	19881018	
'18L00781	SJS	EN	19881017	19881017	C	19890124	
'18L00781	SJS	EN	19881017	19881017	C	19890208	
'18L00781	SJS	EN	19881017	19881017	9	19890330	
'18L00782	SJS	EN	19881017	19890213	C	19881018	
'18L00782	SJS	EN	19881017	19890213	C	19890124	
'18L00782	SJS	EN	19881017	19890213	B	19890213	
'18L00783	GSR	D6	19881017	19881017	C	19881018	
'18L00783	GSR	D6	19881017	19881017	7	19881108	22
'18L00783	GSR	D6	19881017	19881017	9	19890109	
'18L00783	GSR	D6	19881017	19881017	W	19881115	
'18L00783	GSR	D6	19881017	19881017	C	19881201	
'18L00784	SJS	EN	19881017	19890301	C	19881018	
'18L00784	SJS	EN	19881017	19890301	2-	19890125	100
'18L00784	SJS	EN	19881017	19890301	B	19890301	
'18L00786	GSR	D6	19881017	19890227	2-	19881028	11
'18L00786	GSR	D6	19881017	19890227	9	19890112	
'18L00786	GSR	D6	19881017	19890227	B	19890227	
'18L00787	SJS	BX	19881017	19881031	A-	19881031	14
'18L00788	GSR	DS	19881018	19890112	C	19881021	
'18L00788	GSR	DS	19881018	19890112	B	19890112	
'18L00789	LMB	E2	19881019	19890314	2-	19881024	5
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'18L00791	LMB	E2	19881019	19890126	B	19890126	
'18L00792	LMB	E2	19881019	19881019	C	19881031	
'18L00792	LMB	E2	19881019	19881019	9	19890301	
'18L00792	LMB	E2	19881019	19881019	2-	19881109	21
'18L00793	GSR	DS	19881019	19890228	2-	19881028	9
'18L00793	GSR	DS	19881019	19890228	B	19890228	
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'18L00797	SEW	E5	19881020	19890331	B	19890331	
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'18L00798	SEW	E5	19881020	19890331	B	19890331	
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'18L00800	SEW	E5	19881020	19890405	B	19890405	
'18L00801	LMB	F4	19881024	19881205	B	19881205	
'18L00802	LMB	F4	19881024	19881205	B	19881205	
'18L00803	LMB	F4	19881024	19881024	C	19881028	
'18L00803	LMB	F4	19881024	19881024	2-	19881130	37

P18L00803	LMB	F4	19881024	19881024	9	19890321
>18L00804	GSR	D6	19881024	19890314	7	19881101
>18L00804	GSR	D6	19881024	19890314	2	19881115 22
>18L00804	GSR	D6	19881024	19890314	C	19881222
P18L00804	GSR	D6	19881024	19890314	B	19890314
P18L00805	LMB	EF	19881024	19890316	C	19881130
P18L00805	LMB	EF	19881024	19890316	2-	19881028 4
P18L00805	LMB	EF	19881024	19890316	B	19890316
P18L00806	EPAN	2F	19881024	19890223	2-	19881028 4
>18L00806	EPAN	2F	19881024	19890223	9	19881206
P18L00806	EPAN	2F	19881024	19890223	B	19890223
P18L00807	EPAN	2F	19881024	19890223	2-	19881028 4
P18L00807	EPAN	2F	19881024	19890223	9	19881206
P18L00807	EPAN	2F	19881024	19890223	B	19890223
P18L00808	JC	DC	19881024	19881230	A-	19881230 67
P18L00809	JC	DC	19881024	19881128	A-	19881128 35
P18L00810	JC	DC	19881024	19881024	2-	19881118 25
P18L00811	GSR	DS	19881027	19881027	C	19881208
P18L00811	GSR	DS	19881027	19881027	2-	19881103 7
P18L00811	GSR	DS	19881027	19881027	9	19890405
P18L00812	SJS	BX	19881027	19881109	A-	19881109 13
P18L00813	SJS	BX	19881027	19881109	A-	19881109 13
P18L00814	LMB	FP	19881027	19881123	A-	19881123 27
P18L00815	SJS	BX	19881027	19881109	A-	19881109 13
P18L00816	SJS	BX	19881027	19881109	A-	19881109 13
P18L00817	JC	DR	19881027	19881027	2-	19890119 - 23
>18L00817	JC	DR	19881027	19881027	2	19890227
P18L00817	JC	DR	19881027	19881027	2	19890321
P18L00818	LMB	F4	19881027	19881121	B	19881121
P18L00819	GSR	DS	19881027	19881031	3	19881031
P18L00820	JC	DR	19881027	19881219	A-	19881219 53
P18L00821	LMB	F4	19881028	19890313	2-	19881031 3
P18L00821	LMB	F4	19881028	19890313	C	19881206
P18L00821	LMB	F4	19881028	19890313	B	19890313
P18L00822	LMB	F4	19881028	19890504	2-	19881031 2
P18L00822	LMB	F4	19881028	19890504	B	19890504
P18L00823	SEW	E5	19881028	19881031	A-	19881031 3
P18L00824	LMB	22	19881102	19881102	2-	19881102 0
P18L00824	LMB	22	19881102	19881102	9	19881206
>18L00824	LMB	22	19881102	19881102	C	19890123
P18L00824	LMB	22	19881102	19881102	U	19890203
P18L00825	SEW	FG	19881107	19881121	B	19881121
P18L00826	GSR	DS	19881107	19881107	2-	19881110 3
>18L00826	GSR	DS	19881107	19881107	C	19890201
>18L00826	GSR	DS	19881107	19881107	9	19890404
P18L00827	JC	DC	19881107	19881128	A-	19881128 21
P18L00828	JC	DC	19881107	19881128	A-	19881128 21
>18L00829	LMB	E2	19881107	19881128	3	19881128
>18L00830	GSR	EP	19881107	19881107	2-	19881110 3
P18L00830	GSR	EP	19881107	19881107	9	19890404
>18L00830	GSR	EP	19881107	19881107	9	19890426
>18L00832	JC	DC	19881107	19881107	2-	19881118 9
>18L00833	JC	DC	19881107	19881107	2-	19881118 9
>18L00834	GSR	D6	19881108	19881108	9	19881110
>18L00834	GSR	D6	19881108	19881108	2-	19881114 6
>18L00834	GSR	D6	19881108	19881108	U	19890109
>18L00834	GSR	D6	19881108	19881108	7	19890109
>18L00834	GSR	D6	19881108	19881108	9	19890306
>18L00834	GSR	D6	19881108	19881108	9	19890417
>18L00835	GSR	D6	19881108	19881110	2	19881110

A = 19.1
R = 63

A = 13.9
R = 53

58

P18L00836	GSR	D6	19881108	19881110	Z	19881110	/
P18L00837	GSR	D6	19881108	19890407	2-	19881109	/
P18L00837	GSR	D6	19881108	19890407	B	19890407	/
P18L00838	GSR	D6	19881108	19890407	2-	19881109	/
P18L00838	GSR	D6	19881108	19890407	B	19890407	/
P18L00839	JC	23	19881108	19881108	2-	19881117	9
P18L00840	SJS	BX	19881108	19881130	A-	19881130	22
P18L00841	SJS	BX	19881108	19881130	A-	19881130	22
P18L00842	LMB	F4	19881108	19881202	B	19881202	
P18L00843	SJS	BX	19881108	19881130	A-	19881130	22
P18L00844	GSR	DS	19881108	19881108	2-	19881110	/
P18L00844	GSR	DS	19881108	19881108	C	19890328	
P18L00845	LMB	E7	19881108	19881108	2-	19881109	/
P18L00846	LMB	F4	19881108	19881123	3	19881123	
P18L00847	GSR	2S	19881108	19890316	2-	19881110	2
P18L00847	GSR	2S	19881108	19890316	B	19890316	
P18L00848	SJS	BX	19881108	19881201	A-	19881201	23
P18L00850	GSR	DS	19881108	19881108	2-	19881110	2
P18L00850	GSR	DS	19881108	19881108	9	19890404	
P18L00851	JC	DC	19881109	19881215	3	19881215	
P18L00852	EPAN	2F	19881109	19890223	2-	19881109	5
P18L00852	EPAN	2F	19881109	19890223	9	19881206	
P18L00852	EPAN	2F	19881109	19890223	B	19890223	
P18L00853	GSR	DH	19881109	19881109	2-	19881130	21
P18L00853	GSR	DH	19881109	19881109	U	19890223	
P18L00854	GSR	D6	19881109	19890330	C	19881212	
P18L00854	GSR	D6	19881109	19890330	2-	19881110	/
P18L00854	GSR	D6	19881109	19890330	9	19890308	
P18L00854	GSR	D6	19881109	19890330	B	19890330	
P18L00855	GSR	DS	19881109	19881109	2-	19881110	/
P18L00855	GSR	DS	19881109	19881109	7	19881216	
P18L00855	GSR	DS	19881109	19881109	U	19890131	
P18L00855	GSR	DS	19881109	19881109	W	19890214	
P18L00855	GSR	DS	19881109	19881109	U	19890320	
P18L00856	GSR	DS	19881109	19890111	2-	19881118	9
P18L00856	GSR	DS	19881109	19890111	B	19890111	
P18L00857	SEW	FG	19881114	19881114	2-	19890206	84
P18L00857	SEW	FG	19881114	19881114	9	19890310	
P18L00857	SEW	FG	19881114	19881114	2	19881215	
P18L00857	SEW	FG	19881114	19881114	C	19890404	
P18L00858	GSR	DS	19881114	19890309	2-	19881118	4
P18L00858	GSR	DS	19881114	19890309	U	19890104	
P18L00858	GSR	DS	19881114	19890309	B	19890309	
P18L00859	GSR	DE	19881114	19881115	A-	19881115	/
P18L00860	JC	DJ	19881114	19890124	B	19890124	
P18L00861	JC	DC	19881114	19881114	2-	19881116	2
P18L00861	JC	DC	19881114	19881114	U	19890223	
P18L00861	JC	DC	19881114	19881114	W	19890321	
P18L00862	LMB	E7	19881114	19881114	2-	19881118	4
P18L00863	GSR	D6	19881115	19890201	C	19881201	
P18L00863	GSR	D6	19881115	19890201	9	19890113	
P18L00863	GSR	D6	19881115	19890201	3	19890201	
P18L00864	SEW	E5	19881115	19890330	2-	19881116	/
P18L00864	SEW	E5	19881115	19890330	2	19881209	
P18L00864	SEW	E5	19881115	19890330	U	19890113	
P18L00864	SEW	E5	19881115	19890330	B	19890330	
P18L00865	LMB	EF	19881115	19881202	B	19881202	
P18L00866	SJS	BX	19881115	19881130	A-	19881130	15
P18L00867	GSR	EP	19881115	19881115	2-	19881118	2
P18L00867	GSR	EP	19881115	19881115	9	19890404	

P18L00867	GSR	EP	19881115	19881115	9	19890426	
P18L00868	CFO	F3	19881118	19881121	A-	19881121	3
P18L00869	SEW	E5	19881118	19890223	X	19881205	
P18L00869	SEW	E5	19881118	19890223	A-	19890223	97
P18L00870	GSR	EP	19881121	19881202	B	19881202	
P18L00871	SJS	BX	19881121	19881130	A-	19881130	9
P18L00872	LMB	FP	19881121	19881201	A	19881201	10
P18L00873	JC	DC	19881121	19881121	2-	19890112	52
P18L00873	JC	DC	19881121	19881121	W	19890321	
P18L00874	SEW	FG	19881121	19881205	B	19881205	
P18L00875	GSR	DH	19881121	19881123	Z	19881123	
P18L00876	LMB	FP	19881121	19881201	A-	19881201	10
P18L00877	LMB	FR	19881121	19881201	A-	19881201	10
P18L00878	LMB	EF	19881123	19881123	2-	19881123	0
P18L00878	LMB	EF	19881123	19881123	9	19890210	
P18L00878	LMB	EF	19881123	19881123	V	19890208	
P18L00879	LMB	EF	19881123	19881123	2-	19881123	0
P18L00879	LMB	EF	19881123	19881123	V	19890208	
P18L00879	LMB	EF	19881123	19881123	9	19890210	
P18L00880	SEW	FG	19881123	19881123	2-	19881129	6
P18L00880	SEW	FG	19881123	19881123	C	19890119	
P18L00880	SEW	FG	19881123	19881123	9	19890330	
P18L00881	LMB	E2	19881123	19890504	B	19890504	
P18L00882	JC	DC	19881123	19890130	A-	19890130	68
P18L00883	LMB	EF	19881123	19881123	2-	19881123	0
P18L00883	LMB	EF	19881123	19881123	C	19890123	
P18L00883	LMB	EF	19881123	19881123	C	19890221	
P18L00884	LMB	EF	19881201	19881201	2-	19881202	1
P18L00884	LMB	EF	19881201	19881201	9	19890419	
P18L00885	LMB	E2	19881201	19890216	B	19890216	
P18L00886	GSR	DS	19881201	19881206	B	19881206	
P18L00887	LMB	EF	19881201	19881201	2-	19881202	1
P18L00888	GSR	D6	19881201	19890213	C	19881207	
P18L00888	GSR	D6	19881201	19890213	2-	19881215	14
P18L00888	GSR	D6	19881201	19890213	B	19890213	
P18L00889	EPAN	2F	19881201	19890223	2-	19881205	4
P18L00889	EPAN	2F	19881201	19890223	9	19881206	
P18L00889	EPAN	2F	19881201	19890223	B	19890223	
P18L00890	EPAN	2F	19881201	19890223	2-	19881205	4
P18L00890	EPAN	2F	19881201	19890223	9	19881206	
P18L00890	EPAN	2F	19881201	19890223	B	19890223	
P18L00891	GSR	2P	19881201	19890309	2-	19881209	8
P18L00891	GSR	2P	19881201	19890309	B	19890309	
P18L00892	SEW	E5	19881205	19881205	2-	19881208	3
P18L00892	SEW	E5	19881205	19881205	C	19890208	
P18L00892	SEW	E5	19881205	19881205	C	19890208	
P18L00892	SEW	E5	19881205	19881205	C	19890302	
P18L00892	SEW	E5	19881205	19881205	U	19890328	
P18L00893	GSR	D6	19881205	19890406	2-	19881208	3
P18L00893	GSR	D6	19881205	19890406	V	19890327	
P18L00893	GSR	D6	19881205	19890406	B	19890406	
P18L00894	GSR	D6	19881205	19890406	2-	19881208	3
P18L00894	GSR	D6	19881205	19890406	V	19890327	
P18L00894	GSR	D6	19881205	19890406	B	19890406	
P18L00895	GSR	D6	19881205	19890406	2-	19881208	3
P18L00895	GSR	D6	19881205	19890406	U	19890403	
P18L00895	GSR	D6	19881205	19890406	B	19890406	
P18L00896	LMB	F4	19881207	19881215	B	19881215	
P18L00897	SJS	EN	19881207	19890117	X	19881216	
P18L00897	SJS	EN	19881207	19890117	A-	19890117	31

A = 97
R = 97

A = 4.1
R = 14

44

R =

P18L00898	LMB	F4	19881207	19881211	A-	19881211	4
P18L00899	GSR	DS	19881207	19890217	C	19881209	
P18L00899	GSR	DS	19881207	19890217	Z-	19881215	8
P18L00899	GSR	DS	19881207	19890217	B	19890217	
P18L00900	GSR	DE	19881207	19881212	A-	19881212	5
P18L00901	LMB	F4	19881207	19881207	M-	19881229	2
P18L00902	LMB	F4	19881207	19881207	Z-	19881209	2
P18L00902	LMB	F4	19881207	19881207	C	19890119	
P18L00902	LMB	F4	19881207	19881207	U	19890322	
P18L00902	LMB	F4	19881207	19881207	7	19890327	
P18L00903	LMB	FP	19881207	19881215	A-	19881215	8
P18L00904	JC	DC	19881209	19881209	Z-	19890112	3
P18L00904	JC	DC	19881209	19881209	U	19890328	
P18L00904	JC	DC	19881209	19881209	7	19890216	
P18L00905	LMB	F4	19881209	19890327	P-	19881229	20
P18L00905	LMB	F4	19881209	19890327	B	19890327	
P18L00906	EPAN	ZF	19881209	19890223	B	19890223	
P18L00907	JC	DC	19881212	19890111	A-	19890111	30
P18L00908	JC	DC	19881212	19890118	A-	19890118	37
P18L00909	JC	DC	19881212	19890118	A-	19890118	37
P18L00910	JC	DC	19881212	19890104	A-	19890104	23
P18L00911	JC	DC	19881212	19890104	A-	19890104	23
P18L00912	JC	DC	19881212	19890124	Z-	19890112	31
P18L00912	JC	DC	19881212	19890124	A	19890124	
P18L00913	GSR	DS	19881212	19890217	Z-	19881215	3
P18L00913	GSR	DS	19881212	19890217	B	19890217	
P18L00914	GSR	D6	19881216	19890202	Z-	19881219	3
P18L00914	GSR	D6	19881216	19890202	B	19890202	
P18L00915	LMB	F4	19881216	19890403	B	19890403	
P18L00916	GSR	DS	19881216	19881216	C	19881221	
P18L00916	GSR	DS	19881216	19881216	9	19890105	
P18L00916	GSR	DS	19881216	19881216	9	19890307	
P18L00917	GSR	D6	19881216	19881216	Z-	19881223	7
P18L00917	GSR	D6	19881216	19881216	C	19890221	
P18L00918	GSR	D6	19881216	19890405	Z-	19881222	6
P18L00918	GSR	D6	19881216	19890405	B	19890405	
P18L00918	GSR	D6	19881216	19890405	C	19890201	
P18L00919	GSR	D6	19881216	19890104	Z	19890104	
P18L00920	GSR	DS	19881221	19881221	Z-	19881222	1
P18L00920	GSR	DS	19881221	19881221	C	19890223	
P18L00920	GSR	DS	19881221	19881221	9	19890410	
P18L00921	EPAN	ZF	19881221	19890223	B	19890223	
P18L00923	JC	DC	19881221	19890117	A-	19890117	27
P18L00925	JC	DC	19881221	19881221	Z-	19890112	22
P18L00925	JC	DC	19881221	19881221	Z	19890112	
P18L00926	JC	DC	19881221	19881221	Z-	19890111	21
P18L00926	JC	DC	19881221	19881221	U	19890320	
P18L00927	JC	DC	19881221	19890111	A-	19890111	21
P18L00928	JC	DC	19881221	19881221	Z-	19890111	21
P18L00929	GSR	D6	19881221	19890104	Z	19890104	
P18L90050	CFO	D7	19881020	19881020	U	19881031	
P18L90052	CFO	D7	19881109	19881109	U	19881109	
P18L90052	CFO	D7	19881109	19881109	U	19890227	
P18L90055	CFO	D7	19881109	19881109	U	19881130	
P18L90062	CFO	OO	19881205	19890214	U	19881212	
P18L90062	CFO	OO	19881205	19890214	3	19890213	
P18L90062	CFO	OO	19881205	19890214	3	19890214	
P19L00001	GSR	DS	19890105	19890330	Z-	19890125	20
P19L00001	GSR	DS	19890105	19890330	B	19890330	
P19L00002	GSR	ZP	19890105	19890330	Z-	19890120	15

$$A = 20.0$$

$$R = 31$$

$$A = 15^{\circ}$$

$$R = 26$$

35

P19L00002	GSR	2P	19890105	19890330	B	19890330	
P19L00003	LMB	2F	19890105	19890223	B	19890223	
P19L00004	LMB	EF	19890105	19890109	A	19890109	/
P19L00005	JC	DC	19890105	19890109	A	19890109	/
P19L00006	GSR	DS	19890105	19890105	Z-	19890120	15
P19L00006	GSR	DS	19890105	19890105	C	19890417	
P19L00007	GSR	2S	19890105	19890113	A-	19890113	8
P19L00008	GSR	DS	19890105	19890105	Z-	19890123	18
P19L00008	GSR	DS	19890105	19890105	C	19890313	
P19L00008	GSR	DS	19890105	19890105	U	19890418	
P19L00009	GSR	DS	19890105	19890105	Z-	19890123	18
P19L00009	GSR	DS	19890105	19890105	C	19890313	
P19L00009	GSR	DS	19890105	19890105	U	19890418	
P19L00010	GSR	DS	19890106	19890106	C	19890313	
P19L00010	GSR	DS	19890106	19890106	Z-	19890123	17
P19L00010	GSR	DS	19890106	19890106	U	19890418	
P19L00011	GSR	EP	19890106	19890330	Z-	19890124	18
P19L00011	GSR	EP	19890106	19890330	V	19890201	
P19L00011	GSR	EP	19890106	19890330	B	19890330	
P19L00014	GSR	DS	19890106	19890224	Z-	19890123	17
P19L00014	GSR	DS	19890106	19890224	B	19890224	
P19L00015	GSR	DS	19890106	19890330	Z-	19890120	14
P19L00015	GSR	DS	19890106	19890330	B	19890330	
P19L00016	LMB	F4	19890106	19890106	C	19890313	
P19L00016	LMB	F4	19890106	19890106	M-	19890315	58
P19L00016	LMB	F4	19890106	19890106	C	19890427	
P19L00018	GSR	FA	19890106	19890330	Z-	19890117	11
P19L00018	GSR	FA	19890106	19890330	B	19890330	
P19L00019	LMB	E7	19890106	19890106	C	19890118	
P19L00019	LMB	E7	19890106	19890106	Z-	19890124	18
P19L00019	LMB	E7	19890106	19890106	U	19890404	
P19L00020	LMB	22	19890106	19890106	Z-	19890126	20
P19L00021	GSR	EP	19890112	19890417	Z-	19890123	11
P19L00021	GSR	EP	19890112	19890417	A	19890417	
P19L00022	JC	E3	19890112	19890313	Z-	19890124	12
P19L00022	JC	E3	19890112	19890313	A	19890313	
P19L00023	JC	DC	19890112	19890203	A-	19890203	22
P19L00024	JC	DC	19890112	19890308	A-	19890308	55
P19L00025	LMB	ZF	19890112	19890223	B	19890223	
P19L00026	LMB	E2	19890112	19890112	C	19890123	
P19L00026	LMB	E2	19890112	19890112	Z-	19890130	18
P19L00027	SEW	FG	19890112	19890112	Z-	19890123	11
P19L00027	SEW	FG	19890112	19890112	C	19890223	
P19L00027	SEW	FG	19890112	19890112	9	19890330	
P19L00028	JC	DR	19890112	19890124	A-	19890124	12
P19L00029	LMB	EF	19890112	19890112	Z-	19890125	13
P19L00029	LMB	EF	19890112	19890112	U	19890322	
P19L00030	JC	DJ	19890112	19890112	Z-	19890125	13
P19L00031	GSR	D6	19890117	19890117	Z-	19890208	22
P19L00032	LMB	E2	19890117	19890117	Z-	19890124	7
P19L00032	LMB	E2	19890117	19890117	C	19890126	
P19L00033	LMB	F4	19890117	19890117	Z-	19890124	7
P19L00033	LMB	F4	19890117	19890117	5	19890206	
P19L00033	LMB	F4	19890117	19890117	7	19890404	
P19L00034	GSR	D6	19890117	19890117	A-	19890117	0
P19L00035	JC	DC	19890117	19890117	Z-	19890123	6
P19L00035	JC	DC	19890117	19890117	U	19890320	
P19L00036	JC	DC	19890117	19890124	A-	19890124	7
P19L00037	JC	DC	19890117	19890117	Z-	19890123	6
P19L00038	JC	DC	19890117	19890117	Z-	19890123	6

P19L00038	JC	DC	19890117	19890117	2-	19890131	
P19L00039	JC	DC	19890117	19890117	2-	19890123	6
P19L00040	JC	DC	19890117	19890117	2-	19890123	5
P19L00041	GSR	DS	19890117	19890117	2-	19890127	10
P19L00042	LMB	EF	19890117	19890117	U	19890424	
P19L00042	LMB	EF	19890117	19890117	C	19890314	
P19L00042	LMB	EF	19890117	19890117	2-	19890120	3
P19L00042	LMB	EF	19890117	19890117	U	19890420	
P19L00042	LMB	EF	19890117	19890117	C	19890504	
P19L00043	GSR	D6	19890123	19890213	Z	19890213	
P19L00044	GSR	D6	19890123	19890213	Z	19890213	
P19L00045	JC	D7	19890123	19890221	3	19890221	
P19L00046	LMB	2F	19890123	19890223	B	19890223	
P19L00047	GSR	2S	19890123	19890123	2-	19890126	3
P19L00048	GSR	2S	19890123	19890123	2-	19890201	9
P19L00049	GSR	2S	19890123	19890504	X-	19890126	3
P19L00049	GSR	2S	19890123	19890504	C	19890309	
P19L00049	GSR	2S	19890123	19890504	B	19890504	
P19L00050	GSR	DS	19890123	19890123	2-	19890126	3
P19L00050	GSR	DS	19890123	19890123	C	19890404	
P19L00051	LMB	F4	19890124	19890327	B	19890327	
P19L00052	GSR	DS	19890124	19890306	2-	19890201	8
P19L00052	GSR	DS	19890124	19890306	B	19890306	
P19L00053	LMB	E2	19890124	19890124	2-	19890126	2
P19L00053	LMB	E2	19890124	19890124	C	19890321	
P19L00054	LMB	FP	19890124	19890208	7-	19890125	1
P19L00054	LMB	FP	19890124	19890208	B	19890208	
P19L00055	LMB	E2	19890124	19890222	B	19890222	
P19L00056	SEW	EN	19890124	19890213	A-	19890213	20
P19L00057	GSR	DS	19890124	19890124	2-	19890201	8
P19L00057	GSR	DS	19890124	19890124	C	19890404	
P19L00059	GSR	DS	19890124	19890224	2-	19890201	8
P19L00059	GSR	DS	19890124	19890224	B	19890224	
P19L00060	GSR	EP	19890126	19890405	2-	19890126	0
P19L00060	GSR	EP	19890126	19890405	B	19890405	
P19L00061	GSR	D6	19890127	19890214	Z	19890214	
P19L00062	GSR	D6	19890127	19890127	C	19890203	
P19L00062	GSR	D6	19890127	19890127	2-	19890302	34
P19L00063	GSR	D6	19890127	19890127	C	19890203	
P19L00063	GSR	D6	19890127	19890127	2-	19890302	34
P19L00064	GSR	D6	19890127	19890127	C	19890203	
P19L00064	GSR	D6	19890127	19890127	2-	19890302	34
P19L00065	GSR	D6	19890127	19890127	C	19890203	
P19L00065	GSR	D6	19890127	19890127	2-	19890302	34
P19L00066	GSR	D6	19890127	19890127	C	19890203	
P19L00066	GSR	D6	19890127	19890127	2-	19890302	34
P19L00067	GSR	D6	19890127	19890127	C	19890203	
P19L00067	GSR	D6	19890127	19890127	2-	19890302	34
P19L00068	GSR	D6	19890127	19890127	2-	19890208	12
P19L00069	GSR	DS	19890130	19890210	B	19890210	11
P19L00070	GSR	D6	19890130	19890130	2-	19890208	9
P19L00071	GSR	2P	19890202	19890203	3	19890203	
P19L00072	SEW	FG	19890202	19890202	2-	19890206	4
P19L00072	SEW	FG	19890202	19890202	U	19890406	
P19L00073	GSR	DH	19890203	19890222	B	19890222	
P19L00074	GSR	D6	19890203	19890203	2-	19890214	11
P19L00075	GSR	D6	19890203	19890210	Z	19890210	
P19L00076	GSR	D6	19890203	19890210	Z	19890210	
P19L00077	LMB	OO	19890203	19890206	3	19890206	
P19L00078	JC	DC	19890208	19890322	2-	19890215	7

A = 11.8
R = 9

A = 24.0
R = 31

A = 9.9
R = 11

>19L00078	JC	DC	19890208	19890322	3	19890322	
>19L00080	JC	DC	19890208	19890208	2	19890214	b
>19L00080	JC	DC	19890208	19890208	2	19890215	
>19L00081	JC	DC	19890208	19890217	A-	19890217	g
>19L00082	JC	DC	19890208	19890223	A-	19890223	h
>19L00083	JC	DC	19890208	19890208	X-	19890223	i
>19L00084	SEW	EN	19890208	19890501	X-	19890214	g
>19L00084	SEW	EN	19890208	19890501	U	19890324	
>19L00084	SEW	EN	19890208	19890501	B	19890501	
>19L00085	SEW	EN	19890208	19890405	B	19890405	
>19L00086	LMB	E2	19890208	19890403	X-	19890214	h
>19L00086	LMB	E2	19890208	19890403	B	19890403	
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>19L00089	LMB	E2	19890209	19890209	2-	19890216	7
>19L00090	LMB	E2	19890209	19890209	2-	19890301	14
P19L00090	LMB	E2	19890209	19890209	C	19890329	
>19L00091	LMB	E2	19890209	19890209	2-	19890301	14
>19L00091	LMB	E2	19890209	19890209	U	19890419	
>19L00092	GSR	DS	19890209	19890405	2-	19890215	6
>19L00092	GSR	DS	19890209	19890405	B	19890405	
>19L00093	GSR	ZP	19890209	19890209	2-	19890215	6
>19L00094	GSR	DS	19890209	19890209	2-	19890227	18
>19L00095	GSR	D6	19890209	19890209	2-	19890301	20
>19L00095	GSR	D6	19890209	19890209	U	19890315	
>19L00096	GSR	DS	19890209	19890424	2-	19890223	14
>19L00096	GSR	DS	19890209	19890424	C	19890412	
>19L00096	GSR	DS	19890209	19890424	3	19890424	
>19L00096	GSR	DS	19890209	19890424	C	19890421	
>19L00097	GSR	DS	19890209	19890209	2-	19890221	12
>19L00098	LMB	E2	19890209	19890209	7-	19890501	82
>19L00099	LMB	F3	19890210	19890210	2-	19890217	7
>19L00099	LMB	F3	19890210	19890210	C	19890419	
>19L00100	LMB	F3	19890210	19890210	2-	19890216	6
>19L00100	LMB	F3	19890210	19890210	C	19890419	
>19L00101	GSR	D6	19890210	19890221	A-	19890221	11
>19L00102	GSR	D6	19890210	19890210	2-	19890302	20
>19L00103	GSR	D6	19890210	19890214	A-	19890214	4
>19L00104	LMB	E2	19890210	19890320	B	19890320	
>19L00105	LMB	E2	19890210	19890210	X-	19890215	5
>19L00106	GSR	D6	19890213	19890221	A-	19890221	8
>19L00108	LMB	E2	19890215	19890215	C	19890222	
>19L00109	JC	DR	19890215	19890403	2-	19890222	7
>19L00109	JC	DR	19890215	19890403	3	19890403	
>19L00110	LMB	ZF	19890215	19890215	2-	19890221	6
P19L00111	LMB	ZF	19890215	19890215	2-	19890221	6
>19L00112	JC	DC	19890221	19890221	2-	19890222	1
>19L00113	JC	DC	19890221	19890221	2-	19890224	3
>19L00114	JC	DC	19890221	19890221	2-	19890223	2
>19L00115	JC	DC	19890221	19890308	A-	19890308	15
>19L00116	GSR	DS	19890221	19890221	2-	19890221	0
>19L00116	GSR	DS	19890221	19890221	C	19890221	
>19L00117	GSR	ZS	19890221	19890323	2-	19890301	8
>19L00117	GSR	ZS	19890221	19890323	3	19890323	
>19L00118	GSR	ZS	19890221	19890221	2-	19890301	8
>19L00119	GSR	ZS	19890221	19890323	2-	19890301	8
>19L00119	GSR	ZS	19890221	19890323	3	19890323	
>19L00120	SEW	EN	19890223	19890405	2-	19890301	6
>19L00120	SEW	EN	19890223	19890405	B	19890405	
19L00121	SEW	EN	19890223	19890405	2-	19890301	6

PL00121	SEW	EN	19890223	19890405	B	19890405
PL00122	GSR	DS	19890223	19890223	2	19890309
PL00122	GSR	DS	19890223	19890223	U	19890403
PL00123	LMB	F4	19890223	19890223	C	19890308
PL00123	LMB	F4	19890223	19890223	M	19890313
PL00124	JC	DC	19890223	19890223	2	19890227
PL00124	JC	DC	19890223	19890223	4	19890328
PL00125	GSR	2S	19890223	19890223	2	19890309
PL00126	GSR	DS	19890223	19890223	2	19890313
PL00127	LMB	E7	19890223	19890223	2	19890306
PL00128	GSR	D6	19890223	19890223	2	19890301
PL00130	GSR	D6	19890223	19890223	2	19890301
PL00130	GSR	D6	19890223	19890223	U	19890426
PL00131	GSR	DS	19890223	19890309	B	19890309
PL00132	LMB	F4	19890223	19890327	B	19890327
PL00133	SEW	FG	19890224	19890224	2	19890306
PL00133	SEW	FG	19890224	19890224	9	19890401
PL00134	SEW	FG	19890224	19890224	2	19890306
PL00134	SEW	FG	19890224	19890224	9	19890401
PL00135	LMB	2F	19890303	19890324	B	19890324
PL00136	LMB	E2	19890303	19890303	2	19890310
PL00137	SEW	FG	19890303	19890303	2	19890306
PL00137	SEW	FG	19890303	19890303	9	19890401
PL00138	SEW	FG	19890303	19890303	2	19890306
PL00138	SEW	FG	19890303	19890303	9	19890401
PL00139	SEW	E5	19890303	19890331	B	19890331
PL00140	GSR	D6	19890303	19890303	2	19890313
PL00141	GSR	D6	19890303	19890303	2	19890320
PL00142	GSR	D6	19890303	19890303	2	19890313
PL00143	LMB	F4	19890303	19890327	B	19890327
PL00144	SEW	FG	19890303	19890303	2	19890306
PL00144	SEW	FG	19890303	19890303	9	19890401
PL00145	GSR	DH	19890306	19890306	2	19890314
PL00145	GSR	DH	19890306	19890306	C	19890419
PL00146	SEW	FQ	19890306	19890306	2	19890314
PL00146	SEW	FQ	19890306	19890306	U	19890330
PL00147	GSR	EP	19890306	19890306	2	19890313
PL00148	GSR	EP	19890306	19890306	2	19890313
PL00149	SEW	EN	19890306	19890403	B	19890403
PL00150	GSR	DS	19890306	19890404	A	19890404
PL00151	GSR	D6	19890306	19890322	B	19890322
PL00152	LMB	F4	19890306	19890321	B	19890321
PL00152	LMB	F4	19890306	19890321	2	19890403
PL00153	LMB	E2	19890306	19890320	B	19890320
PL00154	GSR	EP	19890306	19890306	2	19890314
PL00155	GSR	D6	19890307	19890307	2	19890320
PL00157	GSR	D6	19890307	19890307	2	19890403
PL00158	GSR	D6	19890307	19890307	2	19890403
PL00158	GSR	D6	19890307	19890307	2	19890403
PL00159	GSR	D6	19890307	19890307	2	19890403
PL00160	GSR	DS	19890308	19890308	C	19890316
PL00161	GSR	DS	19890308	19890308	2	19890322
PL00162	GSR	DS	19890308	19890308	C	19890403
PL00162	GSR	DS	19890308	19890308	2	19890405
PL00162	GSR	DS	19890308	19890308	U	19890501
PL00164	GSR	DS	19890308	19890308	X	19890410
PL00165	LMB	E2	19890308	19890308	2	19890323
PL00166	LMB	E2	19890308	19890308	2	19890323
PL00167	JC	E3	19890308	19890308	2	19890409
PL00168	SEW	EN	19890308	19890308	C	19890404

>19L00169	GSR	D6	19890313	19890313	2-	19890322	9
>19L00169	GSR	D6	19890313	19890313	U	19890501	
>19L00170	SEW	FG	19890313	19890313	2-	19890322	9
>19L00170	SEW	FG	19890313	19890313	U	19890426	
>19L00171	SEW	E5	19890313	19890313	2-	19890401	19
>19L00172	GSR	DS	19890313	19890313	2-	19890411	14
>19L00172	GSR	DS	19890313	19890313	U	19890501	
>19L00174	LMB	F4	19890313	19890313	2-	19890315	2
>19L00175	GSR	EP	19890313	19890313	2-	19890403	2
>19L00176	GSR	EP	19890313	19890313	2-	19890403	2
>19L00177	SEW	E5	19890313	19890313	2-	19890411	19
>19L00180	GSR	DS	19890315	19890315	2-	19890411	7
>19L00181	LMB	EF	19890315	19890324	A-	19890324	9
>19L00183	GSR	DS	19890315	19890315	2-	19890401	17
>19L00183	GSR	DS	19890315	19890315	C	19890411	
>19L00184	JC	E3	19890315	19890324	A-	19890324	9
P19L00185	GSR	D6	19890317	19890317	2-	19890404	18
>19L00186	GSR	D6	19890317	19890317	2-	19890404	18
>19L00187	GSR	D6	19890317	19890317	2-	19890404	18
>19L00188	GSR	D6	19890317	19890317	2-	19890404	18
>19L00189	GSR	D6	19890317	19890317	2-	19890411	25
>19L00190	GSR	DS	19890317	19890317	2-	19890411	25
>19L00190	GSR	DS	19890317	19890317	U	19890501	
P19L00191	GSR	D6	19890317	19890317	2-	19890411	25
P19L00191	GSR	D6	19890317	19890317	U	19890501	
>19L00192	GSR	DS	19890317	19890317	2-	19890411	25
>19L00193	LMB	E2	19890320	19890320	2-	19890320	0
>19L00194	LMB	F4	19890320	19890418	B	19890418	
>19L00195	GSR	DS	19890320	19890330	B	19890330	
>19L00196	LMB	F4	19890320	19890324	B	19890324	
>19L00197	GSR	ZS	19890320	19890320	2-	19890411	22
>19L00198	LMB	EF	19890320	19890320	2-	19890323	3
>19L00199	GSR	DS	19890322	19890322	2-	19890412	21
>19L00200	GSR	DH	19890322	19890322	2-	19890407	16
>19L00203	JC	DC	19890322	19890322	2-	19890420	29
>19L00205	LMB	E2	19890322	19890322	2-	19890323	1
>19L00206	GSR	DS	19890322	19890322	2-	19890417	26
>19L00206	GSR	DS	19890322	19890322	U	19890501	
>19L00207	GSR	DS	19890322	19890322	2-	19890417	26
>19L00207	GSR	DS	19890322	19890322	U	19890501	
>19L00208	LMB	F4	19890322	19890322	2-	19890323	1
>19L00208	LMB	F4	19890322	19890322	C	19890502	
>19L00209	GSR	DS	19890322	19890322	2-	19890411	20
>19L00209	GSR	DS	19890322	19890322	U	19890501	
>19L00210	GSR	D6	19890322	19890322	2-	19890411	20
>19L00211	GSR	D6	19890322	19890322	2-	19890411	20
>19L00212	LMB	EF	19890327	19890412	A-	19890412	16
>19L00213	LMB	EF	19890327	19890412	A-	19890412	16
>19L00214	LMB	E2	19890327	19890327	C	19890328	
>19L00215	LMB	EF	19890327	19890327	2	19890327	
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>19L00217	LMB	E2	19890327	19890327	2-	19890327	0
>19L00218	GSR	D6	19890327	19890329	B	19890329	
>19L00222	LMB	EF	19890328	19890328	W	19890403	
>19L00223	LMB	EF	19890328	19890328	2-	19890403	6
>19L00224	LMB	EF	19890328	19890328	2-	19890404	7
>19L00225	LMB	EF	19890328	19890328	2-	19890404	7
>19L00226	LMB	EF	19890328	19890328	2-	19890404	7
>19L00227	LMB	EF	19890328	19890328	2-	19890404	7
19L00228	LMB	ZF	19890328	19890328	2-	19890404	7

>19L00229	LMB	E2	19890328	19890328	2-	19890330	2
>19L00230	GSR	2S	19890330	19890330	2-	19890413	4
>19L00230	GSR	2S	19890330	19890330	2	19890420	
>19L00231	GSR	2S	19890330	19890330	2-	19890403	4
>19L00235	JC	DC	19890330	19890330	2-	19890420	2
>19L00239	JC	DC	19890330	19890330	2-	19890409	10
>19L00241	GSR	D6	19890331	19890331	2-	19890413	13
>19L00242	GSR	D6	19890331	19890331	C	19890417	
>19L00242	GSR	D6	19890331	19890331	2-	19890418	6
>19L00243	GSR	D6	19890331	19890331	2-	19890412	12
>19L00244	GSR	DS	19890331	19890331	2	19890412	12
>19L00259	SEW	FQ	19890406	19890406	2-	19890412	6
>19L00260	SEW	FQ	19890406	19890406	2-	19890412	6
>19L00261	LMB	F4	19890406	19890504	B	19890504	
>19L00262	LMB	F4	19890406	19890504	B	19890504	
>19L00265	GSR	D6	19890406	19890406	2-	19890418	12
P19L00266	GSR	DS	19890406	19890406	2-	19890412	6
>19L00267	GSR	D6	19890406	19890501	B	19890501	
>19L00273	LMB	EF	19890407	19890407	2-	19890407	0
>19L00275	GSR	DS	19890407	19890501	C	19890410	
>19L00275	GSR	DS	19890407	19890501	B	19890501	
>19L00276	LMB	EF	19890407	19890407	2-	19890407	0
P19L00277	LMB	EF	19890407	19890407	2-	19890407	0
P19L00278	SEW	E5	19890408	19890408	X-	19890419	11
P19L00279	LMB	E2	19890408	19890408	2-	19890413	5
>19L00280	SEW	E5	19890408	19890408	X-	19890419	11
>19L00282	SEW	FQ	19890408	19890408	2-	19890412	4
>19L00287	LMB	EF	19890408	19890417	A-	19890417	9
>19L00288	LMB	EF	19890408	19890417	A-	19890417	9
>19L00297	GSR	D6	19890408	19890408	C	19890411	
P19L00304	LMB	2F	19890412	19890412	2-	19890414	2
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>19L00306	LMB	E2	19890412	19890412	2-	19890413	1
>19L00308	GSR	DS	19890412	19890412	2-	19890419	7
>19L00309	GSR	D6	19890412	19890412	2-	19890418	6
>19L00310	GSR	D6	19890412	19890412	2-	19890418	6
>19L00311	GSR	D6	19890412	19890412	2-	19890418	6
>19L00312	GSR	DS	19890413	19890413	2-	19890419	6
>19L00313	GSR	DS	19890413	19890413	2-	19890419	6
>19L00313	GSR	DS	19890413	19890413	C	19890425	
>19L00315	LMB	F4	19890417	19890427	B	19890427	
>19L00320	LMB	EF	19890417	19890504	B	19890504	
>19L00321	LMB	F4	19890417	19890427	B	19890427	
>19L00322	LMB	F4	19890417	19890427	B	19890427	
>19L00323	LMB	FR	19890417	19890426	A-	19890426	9
>19L00324	LMB	E7	19890417	19890417	2-	19890420	3
>19L00325	LMB	E7	19890417	19890417	2-	19890420	3
>19L00326	LMB	E7	19890417	19890417	2-	19890420	3
>19L00327	LMB	E7	19890417	19890417	2-	19890420	3
>19L00338	LMB	E2	19890422	19890422	2-	19890424	2
>19L00338	LMB	E2	19890422	19890422	P	19890425	
>19L00340	LMB	EF	19890422	19890422	2-	19890424	2
>19L00342	LMB	E2	19890422	19890422	2-	19890424	2
>19L00342	LMB	E2	19890422	19890422	P	19890425	
>19L00343	LMB	E2	19890422	19890422	2-	19890424	2
>19L00343	LMB	E2	19890422	19890422	P	19890425	
>19L00346	LMB	E2	19890426	19890426	C	19890427	
>19L00347	LMB	E2	19890426	19890426	2-	19890427	1
>19L00359	LMB	E2	19890427	19890427	C	19890427	
>19L00367	GSR	DS	19890428	19890428	2-	19890502	4

'19L90011	CFO	00	19890313	19890313	U	19890328
'H9L00001	GSR	EP	19890201	19890201	Z	19890207
'H9L00002	GSR	EP	19890201	19890322	Z	19890207
'H9L00002	GSR	EP	19890201	19890322	B	19890322
'H9L00003	SEW	BX	19890210	19890210	Z	19890216
'H9L00003	SEW	BX	19890210	19890210	U	19890413
'H9L00004	SEW	BX	19890210	19890210	Z	19890216
'H9L00004	SEW	BX	19890210	19890210	U	19890413
'H9L00005	LMB	FR	19890215	19890306	B	19890306
'H9L00006	LMB	FR	19890308	19890324	B	19890324
'H9L00007	GSR	EP	19890313	19890313	Z	19890411
'H9L00008	GSR	DH	19890315	19890330	B	19890330
'H9L00009	LMB	F4	19890328	19890328	C	19890330
'H9L00009	LMB	F4	19890328	19890328	M	19890330
'H9L00015	LMB	FR	19890421	19890504	A	19890504

APPENDIX B
PAD QDRs 1 OCTOBER 1988 - 30 APRIL 1989

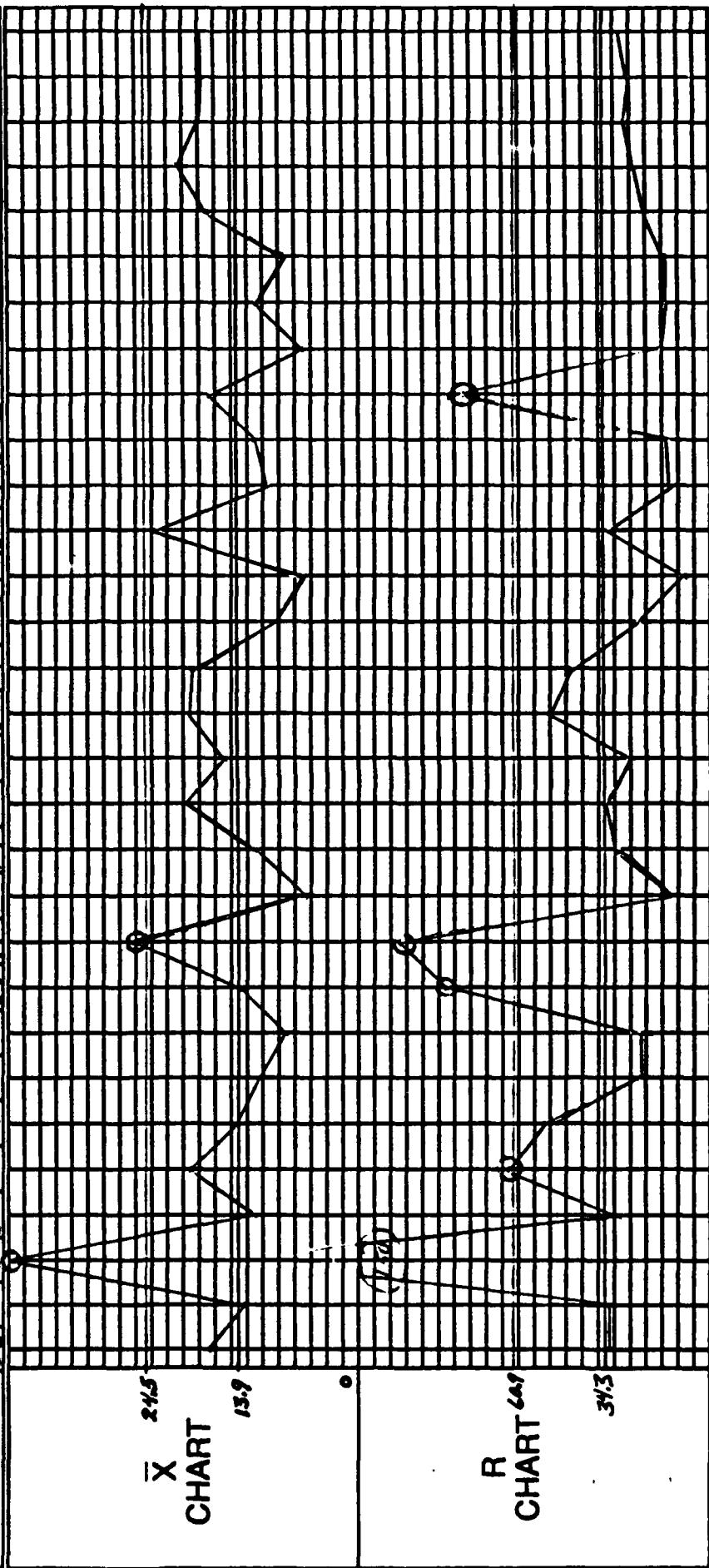


Product Assurance Division

PAD QDR's / Oct 88 - 31 MAR 89

DATE & TIME → NUMBER	SAMPLE READINGS					
	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆
AV =	7.5	12.8	12.2	11.1	12.4	10.3
HIGH X =						
LOW X =						
RANGE R =	3.2	3.3	1.50	3.2	1.3	5.3
	2.1	2.2	0.3	2.1	0.3	3.2
	1.1	1.4	0.3	1.1	0.3	1.4
	0.5	0.7	0.3	0.5	0.7	0.5

$$\bar{X} = \frac{\sum X}{N} = \frac{13.9}{6} = 2.45$$
$$\bar{R} = \frac{\sum R}{n} = \frac{34.3}{6} = 5.72$$
$$UCL_x = \bar{X} + A_2 R = 24.5$$
$$LCL_x = \bar{X} - A_2 R = 3.3$$
$$UCL_R = D_4 R = 60.9$$
$$LCL_R = D_3 R = 9.6$$



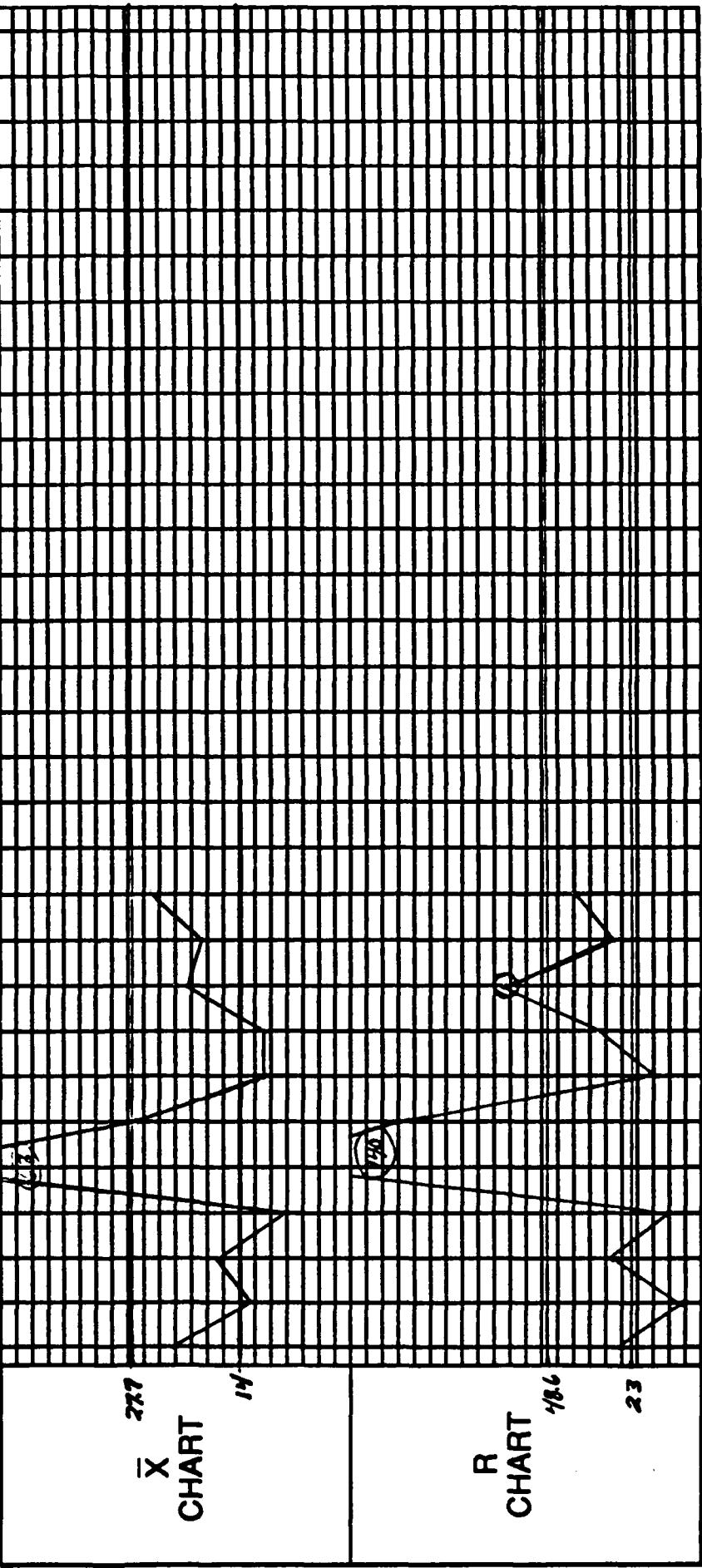
APPENDIX C
PAD QDRs BY MONTH



Product Assurance Division

Oct 88'

DATE & TIME NUMBER	SAMPLE READINGS	RANGE																														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
X ₁	40	14	14	14	14	14	14	14	14	100	8	5	22	35	27	3																
X ₂	29	14	14	5	27	11	21	5	4	25	13	3																				
X ₃	14	14	14	5	67	14	9	5	4	2	13	3																				
X ₄	14	14	9	4	125	5	9	7	4	13	23																					
X ₅	14	8	37	12	22	7	5	37	67	37	53																					
ΣX	111	64	88	40	315	137	52	59	101	93	129																					
AV =	X =	22.2	12.8	17.6	8	6.3	27.1	10.1	11.8	20.2	18.6	25.8																				
HIGH	X =	40	14	37	14	14	165	100	21	37	67	35	53																			
LOW	X =	14	8	9	4	14	5	5	5	4	7	13																				
RANGE	R =	26	6	28	10	140	85	16	32	63	28	40																				

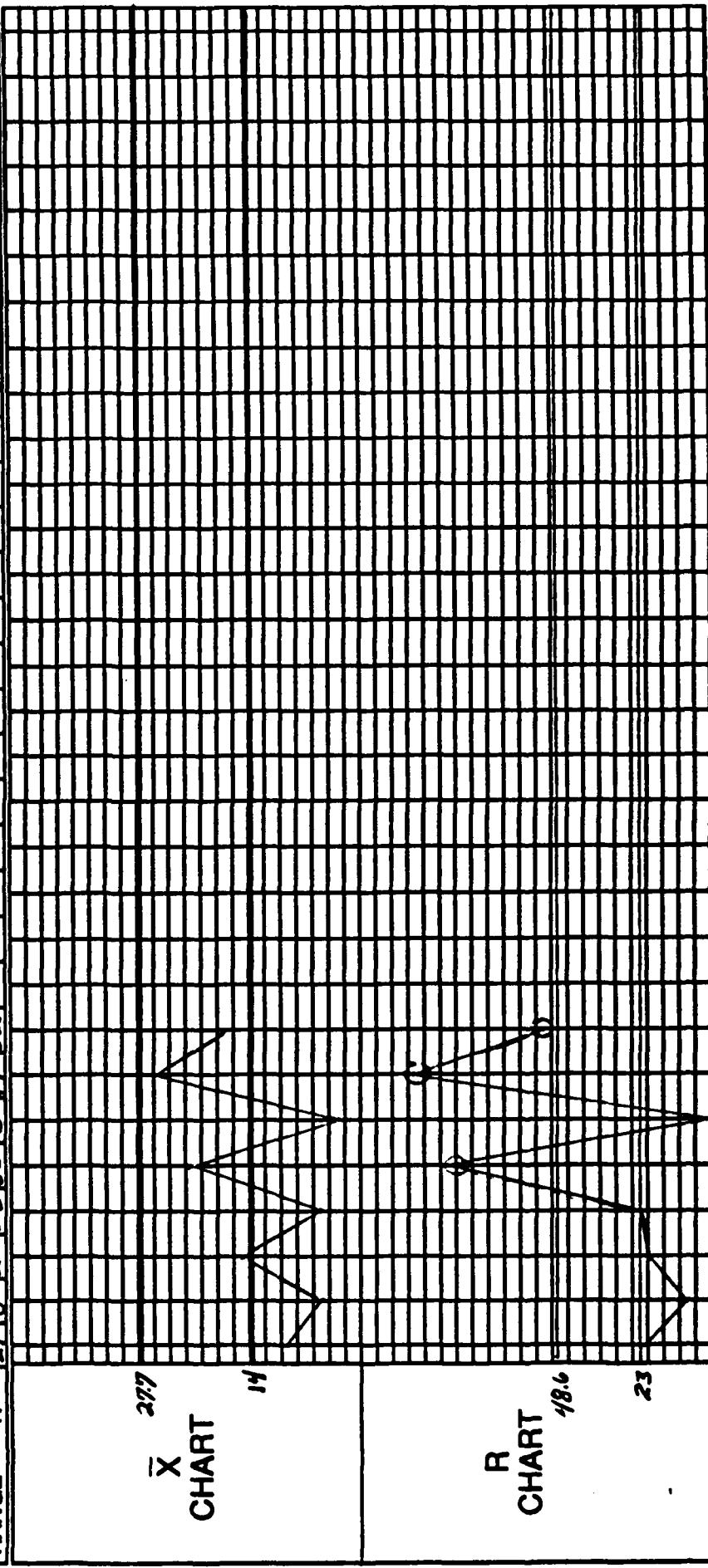


NOV 88



Product Assurance Division

DATE & TIME NUMBER																																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30			
SAMPLE	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇	X ₈	X ₉	X ₁₀	X ₁₁	X ₁₂	X ₁₃	X ₁₄	X ₁₅	X ₁₆	X ₁₇	X ₁₈	X ₁₉	X ₂₀	X ₂₁	X ₂₂	X ₂₃	X ₂₄	X ₂₅	X ₂₆	X ₂₇	X ₂₈	X ₂₉	X ₃₀			
X ₁	0	9	9	1	2	1	4	15	10	0																							
X ₂	3	9	22	2	1	1	3	52	6																								
X ₃	21	6	22	23	1	2	3	10	68																								
X ₄	21	1	22	2	9	4	97	10	0																								
X ₅	3	1	2	0	84	1	9	0																									
ΣX	48	26	77	28	116	112	127	82																									
AV =	X =	9.6	5.2	15.4	5.6	23.2	2.1	25.9	6.1																								
HIGH	X =	21	9	22	23	84	4	97	52																								
LOW	X =	0	1	2	0	1	1	3	0																								
RANGE	R =	21	8	20	23	83	3	64	52																								



$$\bar{X} = \frac{\sum X}{n} = \text{_____}$$

$$UCL_x = \bar{X} + A_2 R = \text{_____}$$

$$LCL_x = \bar{X} - A_2 R = \text{_____}$$

$$UCL_R = D_4 R = \text{_____}$$

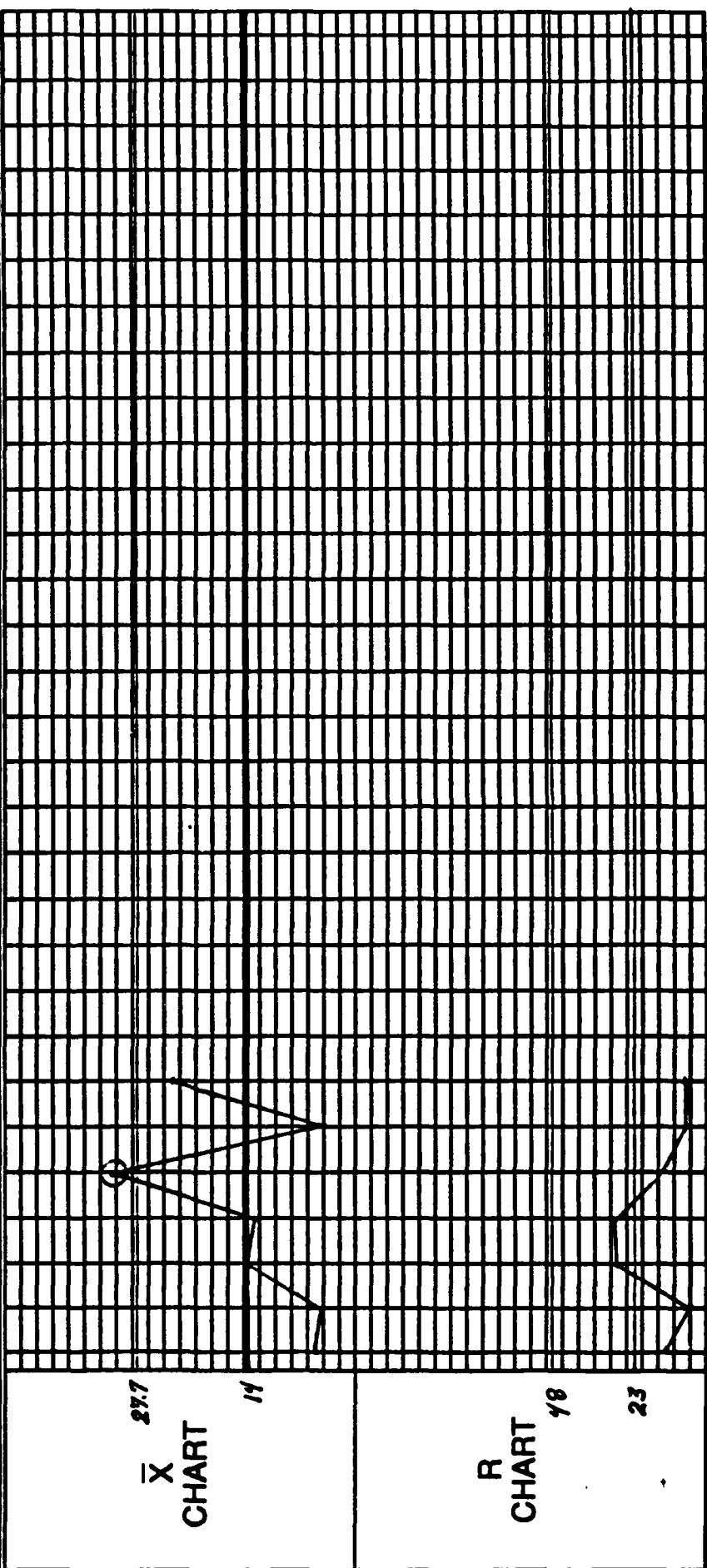
$$LCL_R = D_3 R = \text{_____}$$

DEC 88



Product Assurance Division

DATE & TIME NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
SAMPLE READINGS	X ₁	1	8	31	2	37	3	27																							
X ₂	1	3	4	8	37	3	22																								
X ₃	14	3	8	3	23	7	21																								
X ₄	1	3	5	20	23	6	21																								
X ₅	4	3	22	30	31	1	21																								
ΣX	24	20	70	63	151	20	115																								
AV =	X =	4.8	4	14	12.6	30.2	4	23																							
HIGH X =		14	8	31	30	37	7	27																							
LOW X =		1	3	4	2	23	1	21																							
RANGE R =		13	5	27	28	14	6	6																							



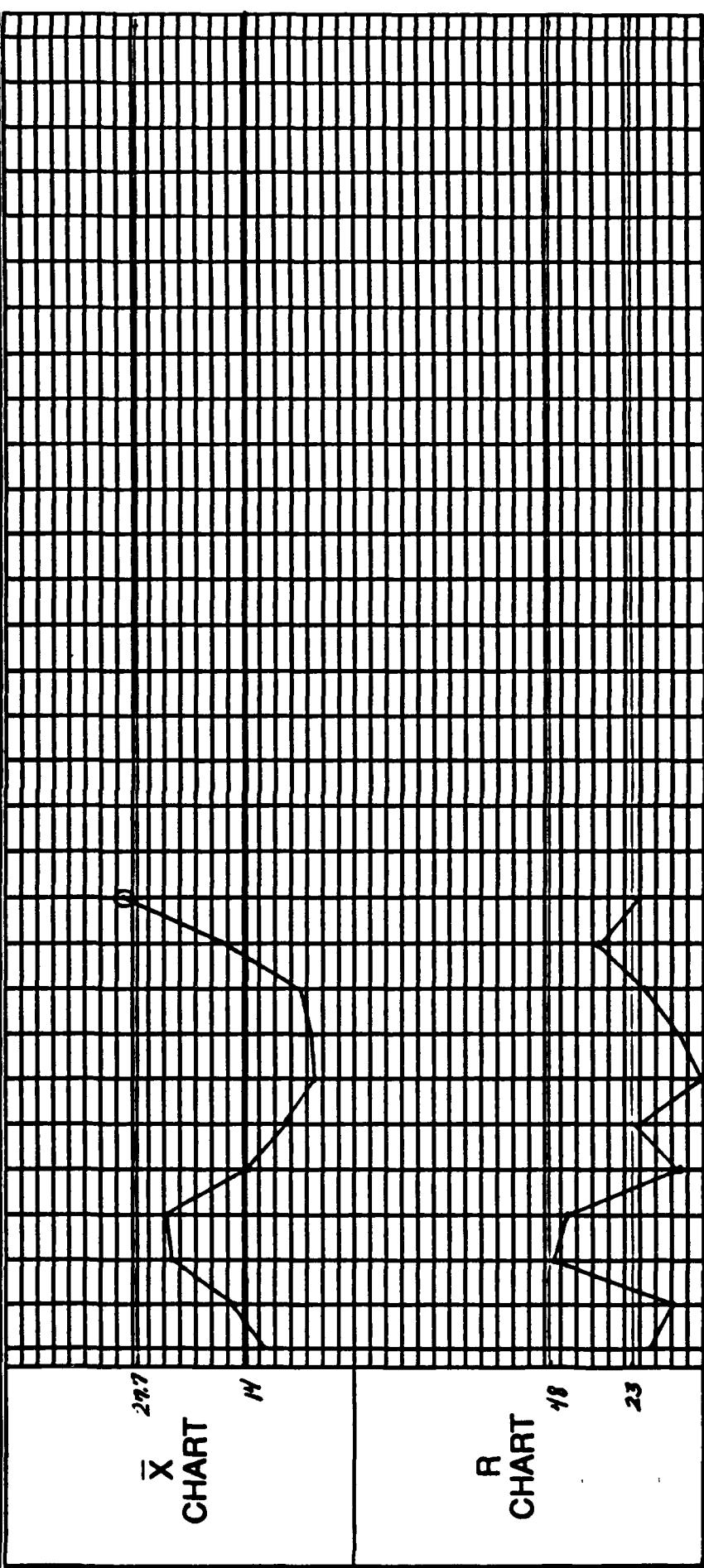


Printed Analysis Data

JAN 89

C-4

		DATE & TIME	NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
SAMPLE	READINGS	X ₁	20	8	17	20	18	22	7	10	3	8	34	11																			
X ₂	15	18	14	11	11	7	6	3	8	8	34	9																					
X ₃	4	18	58	12	12	7	4	3	2	0	34																						
X ₄	4	17	11	22	13	0	6	9	1	34	34																						
X ₅	15	18	18	55	13	6	6	3	20	34	12																						
ΣX	58	79	118	120	67	42	25	28	34	80	148																						
AV =	X =	11.6	15.8	23.4	24	34	8.4	5	5.6	6.8	16	24																					
HIGH	X =	20	18	58	55	18	22	7	10	20	34	34																					
LOW	X =	4	8	11	11	0	6	3	1	0	12																						
RANGE	R =	16	10	47	44	7	22	1	7	19	34	22																					





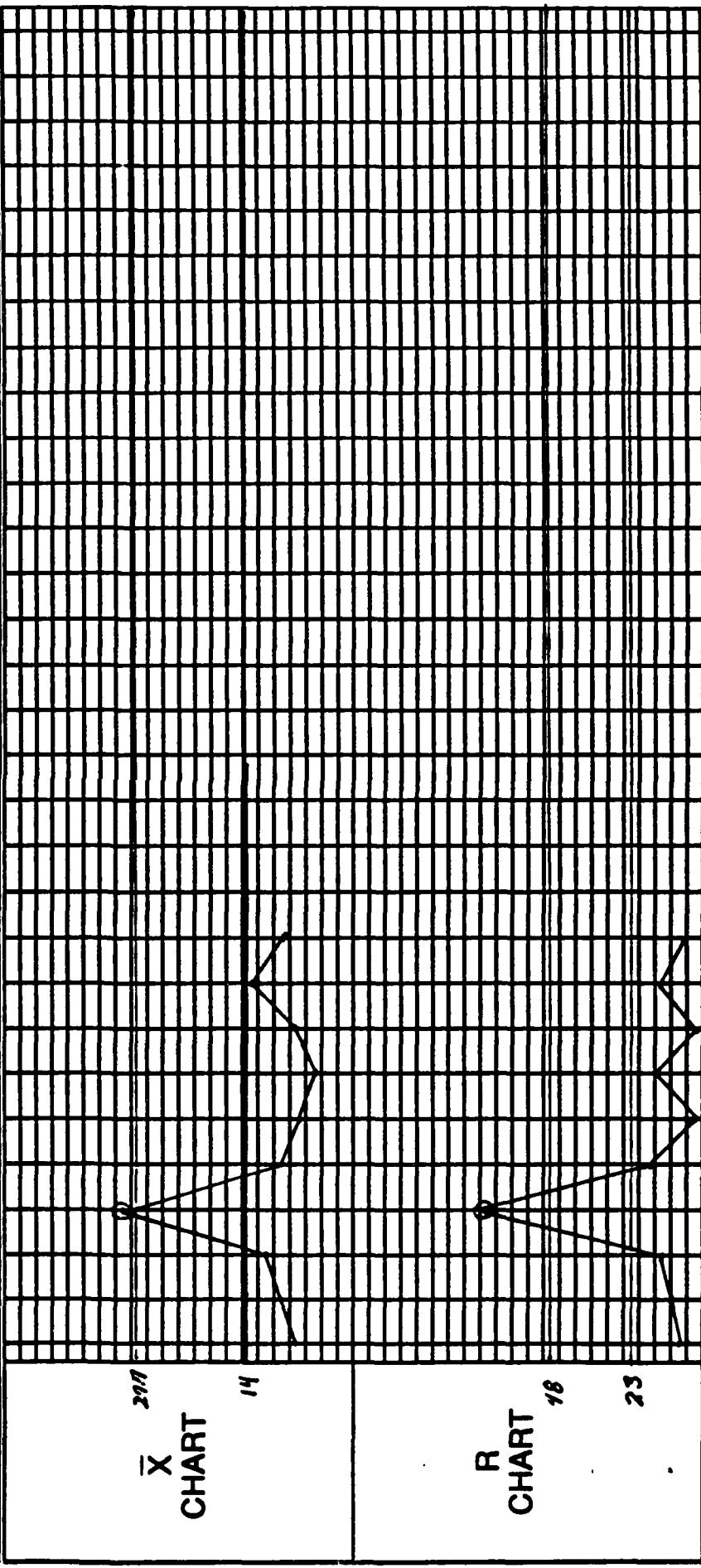
Product Assurance Division

FEB 89

C-5

$$\bar{X} = \frac{\sum X}{M}$$
$$UCL_x = \bar{X} + A_2 R$$
$$LCL_x = \bar{X} - A_2 R$$
$$R = \frac{\sum R}{M}$$
$$UCL_R = D_3 \bar{R}$$
$$LCL_R = D_2 \bar{R}$$

DATE & TIME NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
SAMPLE READINGS	X ₁	4	15	7	18	7	5	1	8	14	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
X ₂	11	15	19	20	6	8	3	8	18	6																					
X ₃	7	6	19	14	11	7	2	8	4	6																					
X ₄	6	6	6	12	20	6	15	6	14	10																					
X ₅	9	5	6	82	4	6	0	6	18	0																					
ΣX	57	47	57	146	48	32	21	36	68	43																					
AV =	X =	7.1	9.1	11.4	22.2	9.6	6.4	1.4	7.2	13.6	4.4																				
HIGH	X =	11	15	19	20	8	15	8	18	11																					
LOW	X =	4	5	6	12	4	5	0	6	4	6																				
RANGE	R =	7	10	13	70	16	3	15	2	14	5																				





Product Assurance Division

MAR 89

C-6

$$\bar{X} = \frac{\sum \bar{X}}{M}$$

$$UCL_x = \bar{X} + A_2 R$$

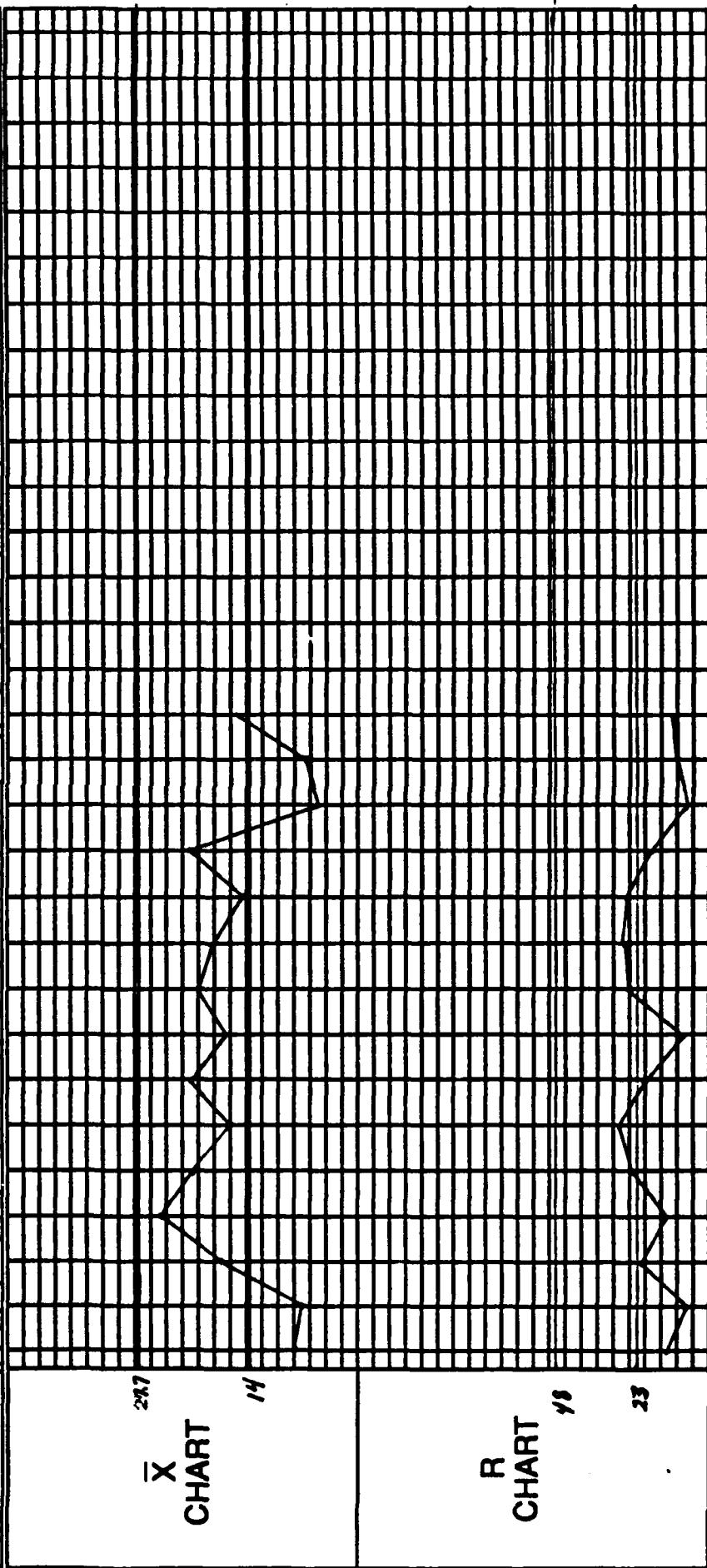
$$LCL_x = \bar{X} - A_2 R$$

$$R = \frac{\sum R}{M}$$

$$UCL_R = D_3 R$$

$$LCL_R = D_4 R$$

DATE & TIME NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30		
SAMPLE READINGS	X ₁	3	3	29	27	15	19	29	18	25	3	26	20	6	7	10																
	X ₂	3	8	28	27	15	29	27	18	25	21	26	16	7	2	13																
	X ₃	10	8	8	14	32	2	9	18	25	14	1	16	7	14	18																
	X ₄	7	7	13	28	9	21	17	18	0	29	20	35	7	4	12																
	ΣX	40	36	95	125	104	80	103	81	100	91	74	107	27	34	74																
AV =	X =	8	7.2	17	24.6	24.9	16	24.6	14.2	20	18.2	14.8	21.4	5.4	6.8	4.8																
HIGH	X =	17	10	29	28	33	29	29	18	25	29	26	35	7	14	21																
LOW	X =	3	3	7	14	9	2	9	9	0	3	1	16	0	4	10																
RANGE	R =	14	7	22	14	24	27	20	9	25	26	25	19	7	10	11																



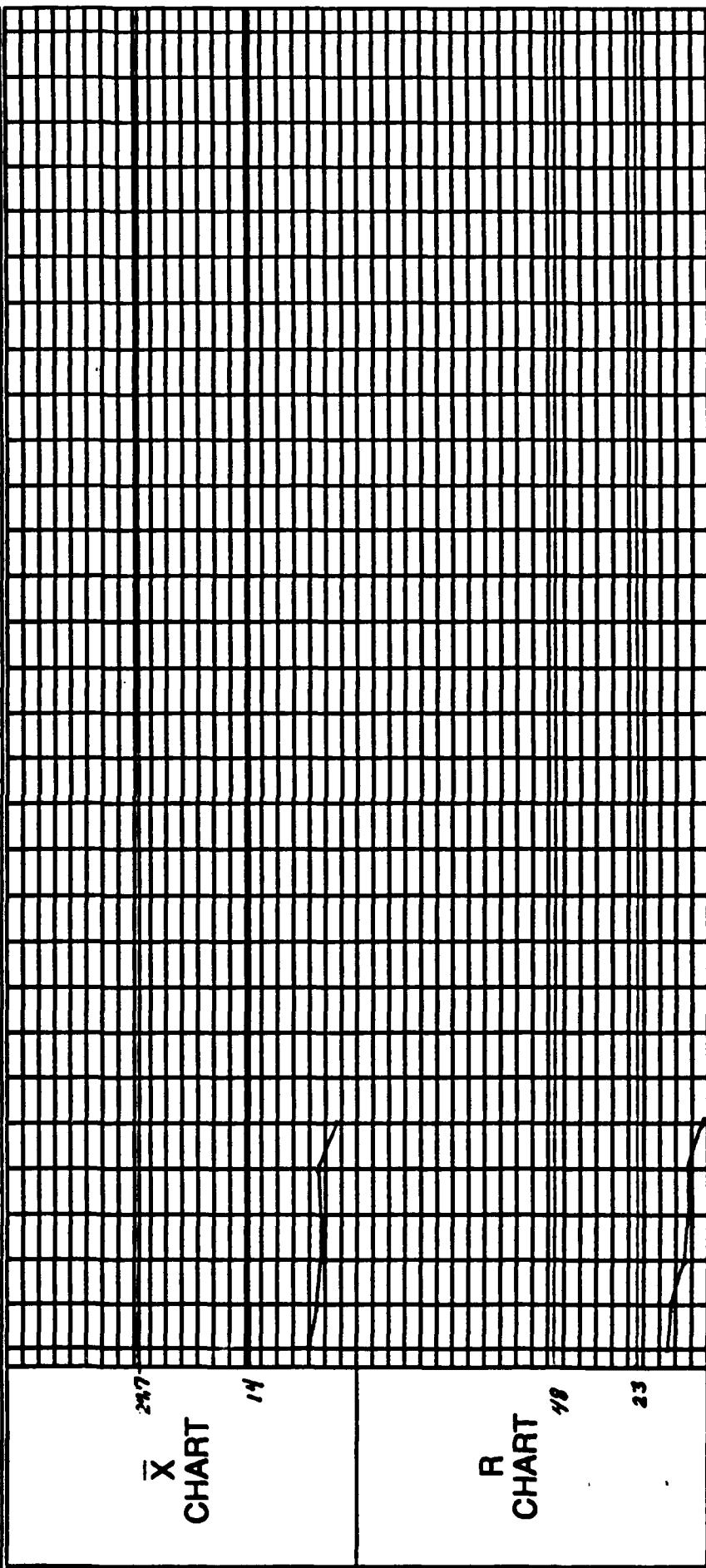


Product Assurance Division

APR 89

C-7

DATE & TIME NUMBER	TIME																																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30			
SAMPLE	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇	X ₈	X ₉	X ₁₀	X ₁₁	X ₁₂	X ₁₃	X ₁₄	X ₁₅	X ₁₆	X ₁₇	X ₁₈	X ₁₉	X ₂₀	X ₂₁	X ₂₂	X ₂₃	X ₂₄	X ₂₅	X ₂₆	X ₂₇	X ₂₈	X ₂₉	X ₃₀			
	X ₁	6	0	4	1	6	3	2																									
	X ₂	6	0	9	7	6	3	1																									
	X ₃	12	11	9	6	9	2	4																									
	X ₄	6	5	2	6	3	2																										
	X ₅	0	11	2	6	3	2																										
	ΣX	30	27	26	26	27	12																										
AV =	X =	6	5.4	5.2	5.2	5.4	2.4																										
HIGH	X =	12	11	9	7	9	3																										
LOW	X =	0	0	2	1	3	2																										
RANGE	R =	12	11	9	6	6	1																										



APPENDIX D
DATA SORT BY ACTION OFFICER

	<u>CSD</u>	<u>C20</u>	<u>C3</u>	<u>C5</u>	<u>C202</u>	<u>C203</u>	<u>(C203 - C3)</u>
SL90062	CFO	00	19881205	19890214	3	19890213	70
SL90062	CFO	00	19881205	19890214	3	19890214	71
SL90062	CFO	00	19881205	19890214	U	19881212	7
PL90011	CFO	00	19890313	19890313	U	19890328	15
SL90050	CFO	D7	19881020	19881020	U	19881031	11
SL90052	CFO	D7	19881109	19881109	U	19890227	110
SL90052	CFO	D7	19881109	19881109	U	19881109	0
SL90055	CFO	D7	19881109	19881109	U	19881130	21
L00868	CFO	F3	19881118	19881121	A	19881121	3
SL00806	EPAN	2F	19881024	19890223	2	19881028	4
SL00806	EPAN	2F	19881024	19890223	9	19881206	43
SL00806	EPAN	2F	19881024	19890223	8	19890223	122
SL00807	EPAN	2F	19881024	19890223	9	19881206	43
SL00807	EPAN	2F	19881024	19890223	8	19890223	122
SL00807	EPAN	2F	19881024	19890223	2	19881028	4
SL00852	EPAN	2F	19881109	19890223	2	19881109	0
SL00852	EPAN	2F	19881109	19890223	8	19890223	106
SL00852	EPAN	2F	19881109	19890223	9	19881206	27
SL00889	EPAN	2F	19881201	19890223	2	19881205	4
SL00889	EPAN	2F	19881201	19890223	9	19881206	5
SL00889	EPAN	2F	19881201	19890223	8	19890223	84
SL00890	EPAN	2F	19881201	19890223	2	19881205	4
SL00890	EPAN	2F	19881201	19890223	9	19881206	5
SL00890	EPAN	2F	19881201	19890223	8	19890223	84
L00906	EPAN	2F	19881209	19890223	8	19890223	76
L00921	EPAN	2F	19881221	19890223	8	19890223	64
L00891	GSR	2P	19881201	19890309	8	19890309	98
L00891	GSR	2P	19881201	19890309	2-	19881209	8-
L00002	GSR	2P	19890105	19890330	2-	19890120	15-
L00002	GSR	2P	19890105	19890330	8	19890330	84
L00071	GSR	2P	19890202	19890203	3	19890203	1
L00093	GSR	2P	19890209	19890209	2-	19890215	6-
L00794	GSR	2S	19881019	19890316	8	19890316	148
L00794	GSR	2S	19881019	19890316	2-	19881028	9-
L00847	GSR	2S	19881108	19890316	2-	19881110	2-
L00847	GSR	2S	19881108	19890316	8	19890316	128
L00007	GSR	2S	19890105	19890113	A-	19890113	8-
L00047	GSR	2S	19890123	19890123	2-	19890126	3-
L00048	GSR	2S	19890123	19890123	2-	19890201	9-
L00049	GSR	2S	19890123	19890504	X-	19890126	3-
L00049	GSR	2S	19890123	19890504	C	19890309	45
L00049	GSR	2S	19890123	19890504	B	19890504	101
L00117	GSR	2S	19890221	19890323	3	19890323	30
L00117	GSR	2S	19890221	19890323	2-	19890301	8-
L00118	GSR	2S	19890221	19890221	2-	19890301	8-
L00119	GSR	2S	19890221	19890323	3	19890323	30
L00119	GSR	2S	19890221	19890323	2-	19890301	8-
L00125	GSR	2S	19890223	19890223	2-	19890309	14-
L00197	GSR	2S	19890320	19890320	2-	19890411	22-
L00230	GSR	2S	19890330	19890330	2-	19890413	14-
L00230	GSR	2S	19890330	19890330	2-	19890420	21-
L00231	GSR	2S	19890330	19890330	2-	19890403	4-
L00772	GSR	D6	19881012	19881012	9	19890118	98
L00772	GSR	D6	19881012	19881012	2-	19881017	5-
L00783	GSR	D6	19881017	19881017	9	19890109	84
L00783	GSR	D6	19881017	19881017	C	19881201	45
L00783	GSR	D6	19881017	19881017	U	19881115	29
L00783	GSR	D6	19881017	19881017	7-	19881108	22-
L00783	GSR	D6	19881017	19881017	C	19881018	1
L00786	GSR	D6	19881017	19890227	2-	19881028	11-

(C203 - C3)

$\bar{f} = 7.2$

$R = 12$

$\bar{f} = 8.2$

$R = 14$

$\bar{f} = 12.1$

$R = 18$

P18L00786	GSR	D6	19881017	19890227	B	19890227	133
P18L00786	GSR	D6	19881017	19890227	9	19890112	87
P18L00804	GSR	D6	19881024	19890314	2	19881115	22
P18L00804	GSR	D6	19881024	19890314	C	19881222	59
P18L00804	GSR	D6	19881024	19890314	7-	19881101	8 -
P18L00834	GSR	D6	19881108	19881108	8	19890314	141
P18L00834	GSR	D6	19881108	19881108	9	19890306	118
P18L00834	GSR	D6	19881108	19881108	7	19890109	62
P18L00834	GSR	D6	19881108	19881108	2	19881114	6 -
P18L00834	GSR	D6	19881108	19881108	W	19890109	62
P18L00834	GSR	D6	19881108	19881108	9	19881110	2
P18L00834	GSR	D6	19881108	19881108	9	19890417	160
P18L00835	GSR	D6	19881108	19881110	2	19881110	2
P18L00836	GSR	D6	19881108	19881110	2	19881110	2
P18L00837	GSR	D6	19881108	19890407	8	19890407	150
P18L00837	GSR	D6	19881108	19890407	2	19881109	1 -
P18L00838	GSR	D6	19881108	19890407	2	19881109	1 -
P18L00838	GSR	D6	19881108	19890407	8	19890407	150
P18L00854	GSR	D6	19881109	19890330	B	19890330	141
P18L00854	GSR	D6	19881109	19890330	2	19881110	1 -
P18L00854	GSR	D6	19881109	19890330	C	19881212	33
P18L00854	GSR	D6	19881109	19890330	9	19890308	119
P18L00863	GSR	D6	19881115	19890201	3	19890201	78
P18L00863	GSR	D6	19881115	19890201	9	19890113	59
P18L00863	GSR	D6	19881115	19890201	C	19881201	16
P18L00888	GSR	D6	19881201	19890213	B	19890213	74
P18L00888	GSR	D6	19881201	19890213	C	19881207	6
P18L00888	GSR	D6	19881201	19890213	2	19881215	14 -
P18L00893	GSR	D6	19881205	19890406	V	19890327	112
P18L00893	GSR	D6	19881205	19890406	B	19890406	122
P18L00893	GSR	D6	19881205	19890406	2	19881208	3 -
P18L00894	GSR	D6	19881205	19890406	V	19890327	112
P18L00894	GSR	D6	19881205	19890406	B	19890406	122
P18L00894	GSR	D6	19881205	19890406	2	19881208	3 -
P18L00895	GSR	D6	19881205	19890406	2	19881208	3 -
P18L00895	GSR	D6	19881205	19890406	B	19890406	122
P18L00895	GSR	D6	19881205	19890406	U	19890403	119
P18L00914	GSR	D6	19881216	19890202	B	19890202	48
P18L00914	GSR	D6	19881216	19890202	7	19881219	3 -
P18L00917	GSR	D6	19881216	19881216	C	19890221	67
P18L00917	GSR	D6	19881216	19881216	2	19881223	7 -
P18L00918	GSR	D6	19881216	19890405	C	19890201	47
P18L00918	GSR	D6	19881216	19890405	B	19890405	110
P18L00918	GSR	D6	19881216	19890405	2	19881222	6 -
P18L00919	GSR	D6	19881216	19890104	Z	19890104	19
P18L00929	GSR	D6	19881221	19890104	Z	19890104	14
P19L00031	GSR	D6	19890117	19890117	Z	19890208	22 -
P19L00034	GSR	D6	19890117	19890117	A	19890117	0 -
P19L00043	GSR	D6	19890123	19890213	Z	19890213	21
P19L00044	GSR	D6	19890123	19890213	Z	19890213	21
P19L00061	GSR	D6	19890127	19890214	Z	19890214	18
P19L00062	GSR	D6	19890127	19890127	Z	19890302	34 -
P19L00062	GSR	D6	19890127	19890127	C	19890203	7
P19L00063	GSR	D6	19890127	19890127	Z	19890302	34 -
P19L00063	GSR	D6	19890127	19890127	C	19890203	7
P19L00064	GSR	D6	19890127	19890127	Z	19890302	34 -
P19L00064	GSR	D6	19890127	19890127	C	19890203	7
P19L00065	GSR	D6	19890127	19890127	Z	19890302	34 -
P19L00065	GSR	D6	19890127	19890127	C	19890203	7
P19L00066	GSR	D6	19890127	19890127	Z	19890302	34 -

P19L00066	GSR	D6	19890127	19890127	C	19890203	7
P19L00067	GSR	D6	19890127	19890127	2	19890302	34
P19L00067	GSR	D6	19890127	19890127	C	19890203	7
P19L00068	GSR	D6	19890127	19890127	2	19890208	12
P19L00070	GSR	D6	19890130	19890130	2	19890208	9
P19L00074	GSR	D6	19890203	19890203	2	19890214	11
P19L00075	GSR	D6	19890203	19890210	2	19890210	7
P19L00076	GSR	D6	19890203	19890210	2	19890210	7
P19L00095	GSR	D6	19890209	19890209	2	19890301	20
P19L00095	GSR	D6	19890209	19890209	U	19890315	34
P19L00101	GSR	D6	19890210	19890221	A	19890221	11
P19L00102	GSR	D6	19890210	19890210	2	19890302	20
P19L00103	GSR	D6	19890210	19890214	A	19890214	4
P19L00106	GSR	D6	19890213	19890221	A	19890221	8
P19L00128	GSR	D6	19890223	19890223	2	19890301	6
P19L00130	GSR	D6	19890223	19890223	U	19890426	62
P19L00130	GSR	D6	19890223	19890223	2	19890301	6
P19L00140	GSR	D6	19890303	19890303	2	19890313	10
P19L00141	GSR	D6	19890303	19890303	2	19890320	17
P19L00142	GSR	D6	19890303	19890303	2	19890313	10
P19L00151	GSR	D6	19890306	19890322	8	19890322	16
P19L00155	GSR	D6	19890307	19890307	2	19890320	13
P19L00157	GSR	D6	19890307	19890307	2	19890403	27
P19L00158	GSR	D6	19890307	19890307	2	19890403	27
P19L00158	GSR	D6	19890307	19890307	2	19890403	27
P19L00159	GSR	D6	19890307	19890307	2	19890403	27
P19L00169	GSR	D6	19890313	19890313	U	19890501	49
P19L00169	GSR	D6	19890313	19890313	2	19890322	9
P19L00185	GSR	D6	19890317	19890317	2	19890404	18
P19L00186	GSR	D6	19890317	19890317	2	19890404	18
P19L00187	GSR	D6	19890317	19890317	2	19890404	18
P19L00188	GSR	D6	19890317	19890317	2	19890404	18
P19L00189	GSR	D6	19890317	19890317	2	19890411	25
P19L00191	GSR	D6	19890317	19890317	U	19890501	45
P19L00191	GSR	D6	19890317	19890317	2	19890411	25
P19L00210	GSR	D6	19890322	19890322	2	19890411	20
P19L00211	GSR	D6	19890322	19890322	2	19890411	20
P19L00218	GSR	D6	19890327	19890329	B	19890329	2
P19L00241	GSR	D6	19890331	19890331	2	19890413	13
P19L00242	GSR	D6	19890331	19890331	2	19890418	18
P19L00242	GSR	D6	19890331	19890331	C	19890417	17
P19L00243	GSR	D6	19890331	19890331	2	19890412	12
P19L00265	GSR	D6	19890406	19890406	2	19890418	12
P19L00267	GSR	D6	19890406	19890501	B	19890501	25
P19L00297	GSR	D6	19890408	19890408	C	19890411	3
P19L00309	GSR	D6	19890412	19890412	2	19890418	6
P19L00310	GSR	D6	19890412	19890412	2	19890418	6
P19L00311	GSR	D6	19890412	19890412	2	19890418	6
P18L00859	GSR	DE	19881114	19881115	A	19881115	1
P18L00900	GSR	DE	19881207	19881212	A	19881212	5
P18L00853	GSR	DH	19881109	19881109	2	19881130	21
P18L00853	GSR	DH	19881109	19881109	U	19890223	106
P18L00875	GSR	DH	19881121	19881123	Z	19881123	2
P19L00073	GSR	DH	19890203	19890222	B	19890222	19
P19L00145	GSR	DH	19890306	19890306	2	19890314	8
P19L00145	GSR	DH	19890306	19890306	C	19890419	44
P19L00200	GSR	DH	19890322	19890322	2	19890407	16
P19L00008	GSR	DH	19890315	19890330	B	19890330	15
P18L00761	GSR	DS	19881005	19890102	3	19890102	89
P18L00762	GSR	DS	19881005	19890227	9	19890109	96

P18L00762	GSR	DS	19881005	19890227	C	19881114	40
P18L00762	GSR	DS	19881005	19890227	B	19890227	145
P18L00762	GSR	DS	19881005	19890227	2	19881011	6 -
P18L00763	GSR	DS	19881005	19890217	2	19881019	14 -
P18L00763	GSR	DS	19881005	19890217	B	19890217	135
P18L00763	GSR	DS	19881005	19890217	P	19881025	20
P18L00763	GSR	DS	19881005	19890217	9	19890109	96
P18L00764	GSR	DS	19881005	19890217	2	19881019	14 -
P18L00764	GSR	DS	19881005	19890217	9	19890109	96
P18L00764	GSR	DS	19881005	19890217	B	19890217	135
P18L00765	GSR	DS	19881005	19890217	2	19881019	14 -
P18L00765	GSR	DS	19881005	19890217	9	19890109	96
P18L00765	GSR	DS	19881005	19890217	B	19890217	135
P18L00767	GSR	DS	19881012	19890301	B	19890301	140
P18L00767	GSR	DS	19881012	19890301	X	19881021	9 -
P18L00773	GSR	DS	19881013	19881013	9	19890101	80
P18L00773	GSR	DS	19881013	19881013	9	19890321	159
P18L00773	GSR	DS	19881013	19881013	C	19890301	139
P18L00773	GSR	DS	19881013	19881013	2	19881017	4 -
P18L00788	GSR	DS	19881018	19890112	C	19881018	0
P18L00788	GSR	DS	19881018	19890112	B	19890112	86
P18LC0788	GSR	DS	19881018	19890112	C	19881021	3
P18L00793	GSR	DS	19881019	19890228	B	19890228	132
P18L00793	GSR	DS	19881019	19890228	2	19881028	9 -
P18L00811	GSR	DS	19881027	19881027	C	19881208	42
P18L00811	GSR	DS	19881027	19881027	2	19881103	7 -
P18L00811	GSR	DS	19881027	19881027	9	19890405	160
P18L00819	GSR	DS	19881027	19881031	3	19881031	4
P18L00826	GSR	DS	19881107	19881107	2	19881110	3 -
P18L00826	GSR	DS	19881107	19881107	C	19890201	86
P18L00826	GSR	DS	19881107	19881107	9	19890404	148
P18L00844	GSR	DS	19881108	19881108	C	19890328	140
P18L00844	GSR	DS	19881108	19881108	2	19881110	2 -
P18L00850	GSR	DS	19881108	19881108	9	19890404	147
P18L00850	GSR	DS	19881108	19881108	2	19881110	2 -
P18L00855	GSR	DS	19881109	19881109	W	19890214	97
P18L00855	GSR	DS	19881109	19881109	U	19890320	131
P18L00855	GSR	DS	19881109	19881109	2	19881110	1 -
P18L00855	GSR	DS	19881109	19881109	U	19890131	83
P18L00855	GSR	DS	19881109	19881109	7	19881216	37
P18L00856	GSR	DS	19881109	19890111	B	19890111	63
P18L00856	GSR	DS	19881109	19890111	2	19881118	9 -
P18L00858	GSR	DS	19881114	19890309	B	19890309	115
P18L00858	GSR	DS	19881114	19890309	U	19890104	51
P18L00858	GSR	DS	19881114	19890309	2	19881118	4 -
P18L00886	GSR	DS	19881201	19881206	B	19881206	5
P18L00899	GSR	DS	19881207	19890217	C	19881209	2
P18L00899	GSR	DS	19881207	19890217	2	19881215	8 -
P18L00899	GSR	DS	19881207	19890217	B	19890217	72
P18L00913	GSR	DS	19881212	19890217	2	19881215	3 -
P18L00913	GSR	DS	19881212	19890217	B	19890217	67
P18L00916	GSR	DS	19881216	19881216	9	19890307	81
P18L00916	GSR	DS	19881216	19881216	C	19881221	5
P18L00916	GSR	DS	19881216	19881216	9	19890105	20
P18L00920	GSR	DS	19881221	19881221	2	19881222	1 -
P18L00920	GSR	DS	19881221	19881221	9	19890410	110
P18L00920	GSR	DS	19881221	19881221	C	19890223	64
P19L00001	GSR	DS	19890105	19890330	2	19890125	20 -
P19L00001	GSR	DS	19890105	19890330	B	19890330	84
P19L00006	GSR	DS	19890105	19890105	2	19890120	15 -

P19L00006	GSR	DS	19890105	19890105	C	19890417	102
P19L00008	GSR	DS	19890105	19890105	C	19890313	67
P19L00008	GSR	DS	19890105	19890105	2	19890123	18 -
P19L00008	GSR	DS	19890105	19890105	U	19890418	103
P19L00009	GSR	DS	19890105	19890105	2	19890123	18 -
P19L00009	GSR	DS	19890105	19890105	U	19890418	103
P19L00009	GSR	DS	19890105	19890105	C	19890313	67
P19L00010	GSR	DS	19890106	19890106	2	19890123	17 -
P19L00010	GSR	DS	19890106	19890106	C	19890313	66
P19L00010	GSR	DS	19890106	19890106	U	19890418	102
P19L00014	GSR	DS	19890106	19890224	2	19890123	17 -
P19L00014	GSR	DS	19890106	19890224	B	19890224	49
P19L00015	GSR	DS	19890106	19890330	B	19890330	83
P19L00015	GSR	DS	19890106	19890330	2	19890120	14 -
P19L00041	GSR	DS	19890117	19890117	U	19890424	97
P19L00041	GSR	DS	19890117	19890117	2	19890127	10 -
P19L00050	GSR	DS	19890123	19890123	2	19890126	3 -
P19L00050	GSR	DS	19890123	19890123	C	19890404	71
P19L00052	GSR	DS	19890124	19890306	B	19890306	41
P19L00052	GSR	DS	19890124	19890306	2	19890201	8 -
P19L00057	GSR	DS	19890124	19890124	2	19890201	8 -
P19L00057	GSR	DS	19890124	19890124	C	19890404	70
P19L00059	GSR	DS	19890124	19890224	B	19890224	31
P19L00059	GSR	DS	19890124	19890224	2	19890201	8 -
P19L00069	GSR	DS	19890130	19890210	B	19890210	11
P19L00092	GSR	DS	19890209	19890405	B	19890405	55
P19L00092	GSR	DS	19890209	19890405	2	19890215	6 -
P19L00094	GSR	DS	19890209	19890209	2	19890227	18 -
P19L00096	GSR	DS	19890209	19890424	3	19890424	74
P19L00096	GSR	DS	19890209	19890424	C	19890421	71
P19L00096	GSR	DS	19890209	19890424	C	19890412	62
P19L00096	GSR	DS	19890209	19890424	2	19890223	14 -
P19L00097	GSR	DS	19890209	19890209	2	19890221	12 -
P19L00116	GSR	DS	19890221	19890221	C	19890221	0
P19L00116	GSR	DS	19890221	19890221	2	19890221	0 -
P19L00122	GSR	DS	19890223	19890223	U	19890403	39
P19L00122	GSR	DS	19890223	19890223	2	19890309	14 -
P19L00126	GSR	DS	19890223	19890223	2	19890313	18 -
P19L00131	GSR	DS	19890223	19890309	B	19890309	14
P19L00150	GSR	DS	19890306	19890404	A	19890404	29 -
P19L00160	GSR	DS	19890308	19890308	C	19890316	8
P19L00161	GSR	DS	19890308	19890308	2	19890322	14 -
P19L00162	GSR	DS	19890308	19890308	U	19890501	54
P19L00162	GSR	DS	19890308	19890308	2	19890405	28 -
P19L00162	GSR	DS	19890308	19890308	C	19890403	26
P19L00164	GSR	DS	19890308	19890308	X	19890410	33 -
P19L00172	GSR	DS	19890313	19890313	U	19890501	49
P19L00172	GSR	DS	19890313	19890313	2	19890411	29 -
P19L00180	GSR	DS	19890315	19890315	2	19890411	27 -
P19L00183	GSR	DS	19890315	19890315	2	19890401	17 -
P19L00183	GSR	DS	19890315	19890315	C	19890411	27
P19L00190	GSR	DS	19890317	19890317	2	19890411	25 -
P19L00190	GSR	DS	19890317	19890317	U	19890501	45
P19L00192	GSR	DS	19890317	19890317	2	19890411	25 -
P19L00195	GSR	DS	19890320	19890330	B	19890330	10
P19L00199	GSR	DS	19890322	19890322	2	19890412	21 -
P19L00206	GSR	DS	19890322	19890322	2	19890417	26 -
P19L00206	GSR	DS	19890322	19890322	U	19890501	40
P19L00207	GSR	DS	19890322	19890322	U	19890501	40
P19L00207	GSR	DS	19890322	19890322	2	19890417	26 -

P19L00209	GSR	DS	19890322	19890322	U	19890501	40
P19L00209	GSR	DS	19890322	19890322	2	19890411	20 -
P19L00244	GSR	DS	19890331	19890331	2	19890412	12 -
P19L00266	GSR	DS	19890406	19890406	2	19890412	6 -
P19L00275	GSR	DS	19890407	19890501	C	19890410	3
P19L00275	GSR	DS	19890407	19890501	B	19890501	24
P19L00308	GSR	DS	19890412	19890412	2	19890419	7 -
P19L00312	GSR	DS	19890413	19890413	2	19890419	6 -
P19L00313	GSR	DS	19890413	19890413	C	19890425	12
P19L00313	GSR	DS	19890413	19890413	2	19890419	6 -
P19L00367	GSR	DS	19890428	19890428	2	19890502	4 -
P18L00830	GSR	EP	19881107	19881107	9	19890404	148
P18L00830	GSR	EP	19881107	19881107	9	19890426	170
P18L00830	GSR	EP	19881107	19881107	2	19881110	3 -
P18L00867	GSR	EP	19881115	19881115	9	19890404	140
P18L00867	GSR	EP	19881115	19881115	9	19890426	162
P18L00867	GSR	EP	19881115	19881115	2	19881118	3 -
P18L00870	GSR	EP	19881121	19881202	B	19881202	11
P19L00011	GSR	EP	19890106	19890330	B	19890330	83
P19L00011	GSR	EP	19890106	19890330	2	19890124	18 -
P19L00011	GSR	EP	19890106	19890330	V	19890201	26
P19L00021	GSR	EP	19890112	19890417	2	19890123	11 -
P19L00021	GSR	EP	19890112	19890417	A	19890417	95
P19L00060	GSR	EP	19890126	19890405	B	19890405	69
P19L00060	GSR	EP	19890126	19890405	2	19890126	0 -
P19L00147	GSR	EP	19890306	19890306	2	19890313	7 -
P19L00148	GSR	EP	19890306	19890306	2	19890313	7 -
P19L00154	GSR	EP	19890306	19890306	2	19890314	8 -
P19L00175	GSR	EP	19890313	19890313	2	19890403	21 -
P19L00176	GSR	EP	19890313	19890313	2	19890403	21 -
PH9L00001	GSR	EP	19890201	19890201	2	19890207	6 -
PH9L00002	GSR	EP	19890201	19890322	B	19890322	49
PH9L00002	GSR	EP	19890201	19890322	2	19890207	6 -
PH9L00007	GSR	EP	19890313	19890313	2	19890411	29 -
P19L00018	GSR	FA	19890106	19890330	2	19890117	11 -
P19L00018	GSR	FA	19890106	19890330	B	19890330	83
P18L00839	JC	23	19881108	19881108	2	19881117	9 -
P19L00045	JC	D7	19890123	19890221	3	19890221	29
P18L00777	JC	DC	19881013	19881109	A	19881109	27 -
P18L00780	JC	DC	19881017	19881017	7	19890321	155 -
P18L00808	JC	DC	19881024	19881230	A	19881230	67 -
P18L00809	JC	DC	19881024	19881128	A	19881128	35 -
P18L00810	JC	DC	19881024	19881024	2	19881118	25 -
P18L00827	JC	DC	19881107	19881128	A	19881128	21 -
P18L00828	JC	DC	19881107	19881128	A	19881128	21 -
P18L00832	JC	DC	19881107	19881107	2	19881118	11 -
P18L00833	JC	DC	19881107	19881107	2	19881118	11 -
P18L00851	JC	DC	19881109	19881215	3	19881215	36
P18L00861	JC	DC	19881114	19881114	W	19890321	127
P18L00861	JC	DC	19881114	19881114	2	19881116	2 -
P18L00861	JC	DC	19881114	19881114	U	19890223	101
P18L00873	JC	DC	19881121	19881121	2	19890112	52 -
P18L00873	JC	DC	19881121	19881121	W	19890321	120
P18L00882	JC	DC	19881123	19890130	A	19890130	68 -
P18L00904	JC	DC	19881209	19881209	U	19890328	109
P18L00904	JC	DC	19881209	19881209	2	19890112	34 -
P18L00904	JC	DC	19881209	19881209	7	19890216	69
P18L00907	JC	DC	19881212	19890111	A	19890111	30 -
P18L00908	JC	DC	19881212	19890118	A	19890118	37 -
P18L00909	JC	DC	19881212	19890118	A	19890118	37 -

P18L00910	JC	DC	19881212	19890104	A	19890104	23 -
P18L00911	JC	DC	19881212	19890104	A	19890104	23 -
P18L00912	JC	DC	19881212	19890124	2	19890112	31 -
P18L00912	JC	DC	19881212	19890124	A	19890124	43
P18L00923	JC	DC	19881221	19890117	A	19890117	27 -
P18L00925	JC	DC	19881221	19881221	2	19890112	22 -
P18L00925	JC	DC	19881221	19881221	2	19890112	22
P18L00926	JC	DC	19881221	19881221	U	19890320	89
P18L00926	JC	DC	19881221	19881221	2	19890111	21 -
P18L00927	JC	DC	19881221	19890111	A	19890111	21 -
P18L00928	JC	DC	19881221	19881221	2	19890111	21 -
P19L00005	JC	DC	19890105	19890109	A	19890109	4 -
P19L00023	JC	DC	19890112	19890203	A	19890203	22 -
P19L00024	JC	DC	19890112	19890308	A	19890308	55 -
P19L00035	JC	DC	19890117	19890117	2	19890123	6 -
P19L00035	JC	DC	19890117	19890117	U	19890320	62
P19L00036	JC	DC	19890117	19890124	A	19890124	7 -
P19L00037	JC	DC	19890117	19890117	2	19890123	6 -
P19L00038	JC	DC	19890117	19890117	2	19890123	6 -
P19L00038	JC	DC	19890117	19890117	2	19890131	14
P19L00039	JC	DC	19890117	19890117	2	19890123	6 -
P19L00040	JC	DC	19890117	19890117	2	19890123	6 -
P19L00078	JC	DC	19890208	19890322	2	19890215	7 -
P19L00078	JC	DC	19890208	19890322	3	19890322	42
P19L00080	JC	DC	19890208	19890208	2	19890215	7
P19L00080	JC	DC	19890208	19890208	2	19890214	6 -
P19L00081	JC	DC	19890208	19890217	A	19890217	9 -
P19L00082	JC	DC	19890208	19890223	A	19890223	15 -
P19L00083	JC	DC	19890208	19890208	X	19890223	15 -
P19L00112	JC	DC	19890221	19890221	2	19890222	1 -
P19L00113	JC	DC	19890221	19890221	2	19890224	3 -
P19L00114	JC	DC	19890221	19890221	2	19890223	2 -
P19L00115	JC	DC	19890221	19890308	A	19890308	15 -
P19L00124	JC	DC	19890223	19890223	2	19890227	4 -
P19L00124	JC	DC	19890223	19890223	4	19890328	33
P19L00203	JC	DC	19890322	19890322	2	19890420	29 -
P19L00235	JC	DC	19890330	19890330	2	19890420	21 -
P19L00239	JC	DC	19890330	19890330	2	19890409	10 -
P18L00860	JC	DJ	19881114	19890124	B	19890124	71
P19L00030	JC	DJ	19890112	19890112	2	19890125	13 -
P18L00779	JC	DR	19881013	19881219	A	19881219	67 -
P18L00817	JC	DR	19881027	19881027	2	19890119	84 -
P18L00817	JC	DR	19881027	19881027	2	19890227	123 -
P18L00817	JC	DR	19881027	19881027	2	19890321	145 -
P18L00820	JC	DR	19881027	19881219	A	19881219	53 -
P19L00028	JC	DR	19890112	19890124	A	19890124	12 -
P19L00109	JC	DR	19890215	19890403	2	19890222	7 -
P19L00109	JC	DR	19890215	19890403	3	19890403	47
P18L00768	JC	E3	19881012	19881012	2	19881118	37 -
P19L00022	JC	E3	19890112	19890313	2	19890124	12 -
P19L00022	JC	E3	19890112	19890313	A	19890313	60 -
P19L00167	JC	E3	19890308	19890308	2	19890409	32 -
P19L00184	JC	E3	19890315	19890324	A	19890324	9 -
P19L00077	LMB	00	19890203	19890206	3	19890206	3
P18L00824	LMB	22	19881102	19881102	2	19881102	0 -
P18L00824	LMB	22	19881102	19881102	C	19890123	82
P18L00824	LMB	22	19881102	19881102	U	19890203	93
P18L00824	LMB	22	19881102	19881102	9	19881206	34
P19L00020	LMB	22	19890106	19890106	2	19890126	20 -
P19L00003	LMB	2F	19890105	19890223	B	19890223	49

P19L00025	LMB	2F	19890112	19890223	B	19890223	42
P19L00046	LMB	2F	19890123	19890223	B	19890223	31
P19L00110	LMB	2F	19890215	19890215	2	19890221	6 -
P19L00111	LMB	2F	19890215	19890215	2	19890221	6 -
P19L00135	LMB	2F	19890303	19890324	B	19890324	21
P19L00228	LMB	2F	19890328	19890328	2	19890404	7 -
P19L00304	LMB	2F	19890412	19890412	2	19890414	<u>2 -</u>
P19L00305	LMB	2F	19890412	19890412	2	19890414	2 -
P18L00766	LMB	E2	19881012	19881129	B	19881129	48
P18L00769	LMB	E2	19881012	19881012	X	19881026	14 -
P18L00769	LMB	E2	19881012	19881012	U	19881223	72
P18L00789	LMB	E2	19881019	19890314	9	19890301	133
P18L00789	LMB	E2	19881019	19890314	2	19881024	5 -
P18L00789	LMB	E2	19881019	19890314	B	19890314	146
P18L00790	LMB	E2	19881019	19890314	B	19890314	146
P18L00790	LMB	E2	19881019	19890314	C	19881026	7
P18L00790	LMB	E2	19881019	19890314	2	19881026	<u>7 -</u>
P18L00790	LMB	E2	19881019	19890314	9	19890301	133
P18L00791	LMB	E2	19881019	19890126	B	19890126	99
P18L00791	LMB	E2	19881019	19890126	X	19881027	8 -
P18L00792	LMB	E2	19881019	19881019	9	19890301	133
P18L00792	LMB	E2	19881019	19881019	C	19881031	12
P18L00792	LMB	E2	19881019	19881019	2	19881109	21 -
P18L00795	LMB	E2	19881019	19881019	2	19881024	5 -
P18L00795	LMB	E2	19881019	19881019	C	19890321	153
P18L00829	LMB	E2	19881107	19881128	3	19881128	21
P18L00881	LMB	E2	19881123	19890504	B	19890504	162
P18L00885	LMB	E2	19881201	19890216	B	19890216	77
P19L00026	LMB	E2	19890112	19890112	2	19890130	18 -
P19L00026	LMB	E2	19890112	19890112	C	19890123	11
P19L00032	LMB	E2	19890117	19890117	2	19890124	<u>7 -</u>
P19L00032	LMB	E2	19890117	19890117	C	19890126	<u>9 -</u>
P19L00053	LMB	E2	19890124	19890124	C	19890321	56
P19L00053	LMB	E2	19890124	19890124	2	19890126	2 -
P19L00055	LMB	E2	19890124	19890222	B	19890222	29
P19L00086	LMB	E2	19890208	19890403	X	19890214	6 -
P19L00086	LMB	E2	19890208	19890403	B	19890403	54
P19L00087	LMB	E2	19890208	19890208	X	19890213	5 -
P19L00088	LMB	E2	19890208	19890313	3	19890313	33
P19L00089	LMB	E2	19890209	19890209	2	19890216	7 -
P19L00090	LMB	E2	19890209	19890209	2	19890301	<u>20 -</u>
P19L00090	LMB	E2	19890209	19890209	C	19890329	48
P19L00091	LMB	E2	19890209	19890209	2	19890301	20 -
P19L00091	LMB	E2	19890209	19890209	U	19890419	69
P19L00098	LMB	E2	19890209	19890209	7	19890501	81 -
P19L00104	LMB	E2	19890210	19890320	B	19890320	38
P19L00105	LMB	E2	19890210	19890210	X	19890215	5 -
P19L00108	LMB	E2	19890215	19890215	C	19890222	7
P19L00136	LMB	E2	19890303	19890303	2	19890310	7 -
P19L00153	LMB	E2	19890306	19890320	B	19890320	14
P19L00165	LMB	E2	19890308	19890308	2	19890323	<u>15 -</u>
P19L00166	LMB	E2	19890308	19890308	2	19890323	15 -
P19L00193	LMB	E2	19890320	19890320	2	19890320	0 -
P19L00205	LMB	E2	19890322	19890322	2	19890323	1 -
P19L00214	LMB	E2	19890327	19890327	C	19890328	1
P19L00217	LMB	E2	19890327	19890327	2	19890327	0 -
P19L00229	LMB	E2	19890328	19890328	2	19890330	<u>2 -</u>
P19L00279	LMB	E2	19890408	19890408	2	19890413	<u>5 -</u>
P19L00306	LMB	E2	19890412	19890412	2	19890413	1 -
P19L00338	LMB	E2	19890422	19890422	2	19890424	2 -

P19L00338	LMB	E2	19890422	19890422	P	19890425	3
P19L00342	LMB	E2	19890422	19890422	P	19890425	3
P19L00342	LMB	E2	19890422	19890422	2	19890424	2 -
P19L00343	LMB	E2	19890422	19890422	2	19890424	2 -
P19L00343	LMB	E2	19890422	19890422	P	19890425	3
P19L00346	LMB	E2	19890426	19890426	C	19890427	1
P19L00347	LMB	E2	19890426	19890426	2	19890427	1 -
P19L00359	LMB	E2	19890427	19890427	C	19890427	0
P18L00845	LMB	E7	19881108	19881108	2	19881109	1 -
P18L00862	LMB	E7	19881114	19881114	2	19881118	4 -
P19L00019	LMB	E7	19890106	19890106	C	19890118	12
P19L00019	LMB	E7	19890106	19890106	2	19890124	18 -
P19L00019	LMB	E7	19890106	19890106	U	19890404	88
P19L00127	LMB	E7	19890223	19890223	2	19890306	11 -
P19L00324	LMB	E7	19890417	19890417	2	19890420	3 -
P19L00325	LMB	E7	19890417	19890417	2	19890420	3 -
P19L00326	LMB	E7	19890417	19890417	2	19890420	3 -
P19L00327	LMB	E7	19890417	19890417	2	19890420	3 -
P18L00752	LMB	EF	19881005	19881114	A	19881114	40 -
P18L00753	LMB	EF	19881005	19881005	9	19890209	127 -
P18L00753	LMB	EF	19881005	19881005	V	19890208	126
P18L00753	LMB	EF	19881005	19881005	2	19881103	29 -
P18L00771	LMB	EF	19881012	19890405	9	19890321	160
P18L00771	LMB	EF	19881012	19890405	2	19881017	5 -
P18L00771	LMB	EF	19881012	19890405	B	19890405	175
P18L00805	LMB	EF	19881024	19890316	C	19881130	37
P18L00805	LMB	EF	19881024	19890316	B	19890316	143
P18L00805	LMB	EF	19881024	19890316	2	19881028	4 -
P18L00865	LMB	EF	19881115	19881202	B	19881202	17
P18L00878	LMB	EF	19881123	19881123	V	19890208	77
P18L00878	LMB	EF	19881123	19881123	2	19881123	0 -
P18L00878	LMB	EF	19881123	19881123	9	19890210	79
P18L00879	LMB	EF	19881123	19881123	2	19881123	0 -
P18L00879	LMB	EF	19881123	19881123	9	19890210	79
P18L00879	LMB	EF	19881123	19881123	V	19890208	77
P18L00883	LMB	EF	19881123	19881123	C	19890221	90
P18L00883	LMB	EF	19881123	19881123	C	19890123	61
P18L00883	LMB	EF	19881123	19881123	2	19881123	0 -
P18L00884	LMB	EF	19881201	19881201	2	19881202	1 -
P18L00884	LMB	EF	19881201	19881201	9	19890419	139
P18L00887	LMB	EF	19881201	19881201	2	19881202	1 -
P19L00004	LMB	EF	19890105	19890109	A	19890109	4 -
P19L00029	LMB	EF	19890112	19890112	U	19890322	69
P19L00029	LMB	EF	19890112	19890112	2	19890125	13 -
P19L00042	LMB	EF	19890117	19890117	C	19890314	56 -
P19L00042	LMB	EF	19890117	19890117	2	19890120	3 -
P19L00042	LMB	EF	19890117	19890117	C	19890504	107
P19L00042	LMB	EF	19890117	19890117	U	19890420	93
P19L00181	LMB	EF	19890315	19890324	A	19890324	9 -
P19L00198	LMB	EF	19890320	19890320	2	19890323	3 -
P19L00212	LMB	EF	19890327	19890412	A	19890412	16 -
P19L00213	LMB	EF	19890327	19890412	A	19890412	16 -
P19L00215	LMB	EF	19890327	19890327	2	19890501	35
P19L00215	LMB	EF	19890327	19890327	2	19890327	0 -
P19L00222	LMB	EF	19890328	19890328	W	19890403	6
P19L00223	LMB	EF	19890328	19890328	2	19890403	6 -
P19L00224	LMB	EF	19890328	19890328	2	19890404	7 -
P19L00225	LMB	EF	19890328	19890328	2	19890404	7 -
P19L00226	LMB	EF	19890328	19890328	2	19890404	7 -
P19L00227	LMB	EF	19890328	19890328	2	19890404	7 -

P19L00273	LMB	EF	19890407	19890407	2	19890407	0 -
P19L00276	LMB	EF	19890407	19890407	2	19890407	0 -
P19L00277	LMB	EF	19890407	19890407	2	19890407	0 -
P19L00287	LMB	EF	19890408	19890417	A	19890417	9 -
P19L00288	LMB	EF	19890408	19890417	A	19890417	9 -
P19L00320	LMB	EF	19890417	19890504	B	19890504	17
P19L00340	LMB	EF	19890422	19890422	2	19890424	2 -
P19L00099	LMB	F3	19890210	19890210	C	19890419	68
P19L00099	LMB	F3	19890210	19890210	2	19890217	7 -
P19L00100	LMB	F3	19890210	19890210	C	19890419	68
P19L00100	LMB	F3	19890210	19890210	2	19890216	6 -
P18L00775	LMB	F4	19881013	19881013	9	19890321	159
P18L00775	LMB	F4	19881013	19881013	C	19881221	69
P18L00775	LMB	F4	19881013	19881013	2	19881027	14 -
P18L00776	LMB	F4	19881013	19881121	3	19881121	39
P18L00801	LMB	F4	19881024	19881205	B	19881205	42
P18L00802	LMB	F4	19881024	19881205	B	19881205	42
P18L00803	LMB	F4	19881024	19881024	C	19881028	4
P18L00803	LMB	F4	19881024	19881024	2	19881130	37 -
P18L00803	LMB	F4	19881024	19881024	9	19890321	148
P18L00818	LMB	F4	19881027	19881121	B	19881121	25
P18L00821	LMB	F4	19881028	19890313	B	19890313	136
P18L00821	LMB	F4	19881028	19890313	C	19881206	39
P18L00821	LMB	F4	19881028	19890313	2	19881031	3 -
P18L00822	LMB	F4	19881028	19890504	B	19890504	188
P18L00822	LMB	F4	19881028	19890504	2	19881031	3 -
P18L00842	LMB	F4	19881108	19881202	B	19881202	24
P18L00846	LMB	F4	19881108	19881123	3	19881123	15
P18L00896	LMB	F4	19881207	19881215	B	19881215	8
P18L00898	LMB	F4	19881207	19881211	A	19881211	4 -
P18L00901	LMB	F4	19881207	19881207	M	19881229	22 -
P18L00902	LMB	F4	19881207	19881207	7	19890327	110
P18L00902	LMB	F4	19881207	19881207	2	19881209	2 -
P18L00902	LMB	F4	19881207	19881207	C	19890119	43
P18L00902	LMB	F4	19881207	19881207	U	19890322	105
P18L00905	LMB	F4	19881209	19890327	B	19890327	108
P18L00905	LMB	F4	19881209	19890327	P	19881229	20 -
P18L00915	LMB	F4	19881216	19890403	B	19890403	108
P19L00016	LMB	F4	19890106	19890106	C	19890427	111
P19L00016	LMB	F4	19890106	19890106	M	19890315	68 -
P19L00016	LMB	F4	19890106	19890106	C	19890313	66
P19L00033	LMB	F4	19890117	19890117	5	19890206	20
P19L00033	LMB	F4	19890117	19890117	7	19890124	7 -
P19L00033	LMB	F4	19890117	19890117	7	19890404	77
P19L00051	LMB	F4	19890124	19890327	B	19890327	62
P19L00123	LMB	F4	19890223	19890223	M	19890313	18 -
P19L00123	LMB	F4	19890223	19890223	C	19890308	13
P19L00132	LMB	F4	19890223	19890327	B	19890327	32
P19L00143	LMB	F4	19890303	19890327	B	19890327	24
P19L00152	LMB	F4	19890306	19890321	B	19890321	15
P19L00152	LMB	F4	19890306	19890321	2	19890403	28 -
P19L00174	LMB	F4	19890313	19890313	2	19890315	2 -
P19L00194	LMB	F4	19890320	19890418	B	19890418	29
P19L00196	LMB	F4	19890320	19890324	B	19890324	4
P19L00208	LMB	F4	19890322	19890322	2	19890323	1 -
P19L00208	LMB	F4	19890322	19890322	C	19890502	41
P19L00261	LMB	F4	19890406	19890504	B	19890504	28
P19L00262	LMB	F4	19890406	19890504	B	19890504	28
P19L00315	LMB	F4	19890417	19890427	B	19890427	10
P19L00321	LMB	F4	19890417	19890427	B	19890427	10

P19L00322	LMB	F4	19890417	19890427	8	19890427	10
PH9L00009	LMB	F4	19890328	19890328	M	19890330	2 -
PH9L00009	LMB	F4	19890328	19890328	C	19890330	2
P18L00814	LMB	FP	19881027	19881123	A	19881123	27 -
P18L00872	LMB	FP	19881121	19881201	A	19881201	10 -
P18L00876	LMB	FP	19881121	19881201	A	19881201	10 -
P18L00903	LMB	FP	19881207	19881215	A	19881215	8 -
P19L00054	LMB	FP	19890124	19890208	7	19890125	1 -
P19L00054	LMB	FP	19890124	19890208	B	19890208	15
P18L00877	LMB	FR	19881121	19881201	A	19881201	10 -
P19L00323	LMB	FR	19890417	19890426	A	19890426	9 -
PH9L00005	LMB	FR	19890215	19890306	B	19890306	19
PH9L00006	LMB	FR	19890308	19890324	B	19890324	16
PH9L00015	LMB	FR	19890421	19890504	A	19890504	13 -
PH9L00003	SEW	BX	19890210	19890210	U	19890413	62
PH9L00003	SEW	BX	19890210	19890210	2	19890216	6 -
PH9L00004	SEW	BX	19890210	19890210	U	19890413	62
PH9L00004	SEW	BX	19890210	19890210	2	19890216	6 -
P18L00774	SEW	E5	19881013	19881212	B	19881212	60
P18L00774	SEW	E5	19881013	19881212	U	19881114	32
P18L00774	SEW	E5	19881013	19881212	X	19881025	12 -
P18L00796	SEW	E5	19881020	19890331	B	19890331	162
P18L00796	SEW	E5	19881020	19890331	2	19881025	5 -
P18L00796	SEW	E5	19881020	19890331	9	19890202	105
P18L00797	SEW	E5	19881020	19890331	B	19890331	162
P18L00797	SEW	E5	19881020	19890331	9	19890202	105
P18L00797	SEW	E5	19881020	19890331	2	19881025	5 -
P18L00798	SEW	E5	19881020	19890331	B	19890331	162
P18L00798	SEW	E5	19881020	19890331	9	19890202	105
P18L00798	SEW	E5	19881020	19890331	2	19881025	5 -
P18L00800	SEW	E5	19881020	19890405	B	19890405	167
P18L00800	SEW	E5	19881020	19890405	U	19890329	160
P18L00800	SEW	E5	19881020	19890405	9	19890202	105
P18L00800	SEW	E5	19881020	19890405	C	19890223	126
P18L00800	SEW	E5	19881020	19890405	2	19881027	7 -
P18L00823	SEW	E5	19881028	19881031	A	19881031	3 -
P18L00864	SEW	E5	19881115	19890330	2	19881209	24 -
P18L00864	SEW	E5	19881115	19890330	B	19890330	135
P18L00864	SEW	E5	19881115	19890330	U	19890113	59
P18L00864	SEW	E5	19881115	19890330	2	19881116	1 -
P18L00869	SEW	E5	19881118	19890223	X	19881205	17 -
P18L00869	SEW	E5	19881118	19890223	A	19890223	97
P18L00892	SEW	E5	19881205	19881205	C	19890302	87
P18L00892	SEW	E5	19881205	19881205	U	19890328	113
P18L00892	SEW	E5	19881205	19881205	2	19881208	3 -
P18L00892	SEW	E5	19881205	19881205	C	19890208	65
P18L00892	SEW	E5	19881205	19881205	C	19890208	65
P19L00139	SEW	E5	19890303	19890331	B	19890331	28
P19L00171	SEW	E5	19890313	19890313	2	19890401	19 -
P19L00177	SEW	E5	19890313	19890313	2	19890411	29 -
P19L00278	SEW	E5	19890408	19890408	X	19890419	11 -
P19L00280	SEW	E5	19890408	19890408	X	19890419	11 -
P19L00056	SEW	EN	19890124	19890213	A	19890213	20 -
P19L00084	SEW	EN	19890208	19890501	B	19890501	82
P19L00084	SEW	EN	19890208	19890501	X	19890214	6 -
P19L00084	SEW	EN	19890208	19890501	U	19890324	44
P19L00085	SEW	EN	19890208	19890405	B	19890405	56
P19L00120	SEW	EN	19890223	19890405	2	19890301	6 -
P19L00120	SEW	EN	19890223	19890405	B	19890405	41
P19L00121	SEW	EN	19890223	19890405	B	19890405	41

P19L00121	SEW	EN	19890223	19890405	2	19890301	6 -
P19L00149	SEW	EN	19890306	19890403	8	19890403	28
P19L00168	SEW	EN	19890308	19890308	C	19890404	27
P18L00754	SEW	FG	19881005	19881212	B	19881212	68
P18L00754	SEW	FG	19881005	19881212	2	19881019	14 -
P18L00755	SEW	FG	19881005	19881212	B	19881212	68
P18L00755	SEW	FG	19881005	19881212	2	19881019	14 -
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P18L00760	SEW	FG	19881005	19881212	B	19881212	68
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P18L00825	SEW	FG	19881107	19881121	B	19881121	14
P18L00857	SEW	FG	19881114	19881114	2	19890206	84
P18L00857	SEW	FG	19881114	19881114	C	19890404	141
P18L00857	SEW	FG	19881114	19881114	2	19881215	<u>31</u> -
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P18L00874	SEW	FG	19881121	19881205	B	19881205	14
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P19L00027	SEW	FG	19890112	19890112	9	19890330	77
P19L00027	SEW	FG	19890112	19890112	C	19890223	42
P19L00027	SEW	FG	19890112	19890112	2	19890123	<u>11</u> -
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P19L00133	SEW	FG	19890224	19890224	2	19890306	10 -
P19L00133	SEW	FG	19890224	19890224	9	19890401	36
P19L00134	SEW	FG	19890224	19890224	9	19890401	36
P19L00134	SEW	FG	19890224	19890224	2	19890306	10 -
P19L00137	SEW	FG	19890303	19890303	9	19890401	29
P19L00137	SEW	FG	19890303	19890303	2	19890306	3 -
P19L00138	SEW	FG	19890303	19890303	9	19890401	29
P19L00138	SEW	FG	19890303	19890303	2	19890306	<u>3</u> -
P19L00144	SEW	FG	19890303	19890303	9	19890401	<u>29</u>
P19L00144	SEW	FG	19890303	19890303	2	19890306	3 -
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P19L00170	SEW	FG	19890313	19890313	2	19890322	9 -
P19L00146	SEW	FQ	19890306	19890306	2	19890314	8 -
P19L00146	SEW	FQ	19890306	19890306	U	19890330	24
P19L00259	SEW	FQ	19890406	19890406	2	19890412	6 -
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P19L00282	SEW	FQ	19890408	19890408	2	19890412	4 -
>18L00787	SJS	BX	19881017	19881031	A	19881031	14
>18L00812	SJS	BX	19881027	19881109	A	19881109	13
>18L00813	SJS	BX	19881027	19881109	A	19881109	<u>13</u>
>18L00815	SJS	BX	19881027	19881109	A	19881109	13
>18L00816	SJS	BX	19881027	19881109	A	19881109	13
>18L00840	SJS	BX	19881108	19881130	A	19881130	<u>22</u>
>18L00841	SJS	BX	19881108	19881130	A	19881130	22
>18L00843	SJS	BX	19881108	19881130	A	19881130	22
>18L00848	SJS	BX	19881108	19881201	A	19881201	<u>23</u>

P18L00866	SJS	BX	19881115	19881130	A	19881130	15 -
P18L00871	SJS	BX	19881121	19881130	A	19881130	9 -
P18L00781	SJS	EN	19881017	19881017	C	19881018	1
P18L00781	SJS	EN	19881017	19881017	C	19890124	99
P18L00781	SJS	EN	19881017	19881017	C	19890208	114
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P18L00782	SJS	EN	19881017	19890213	C	19890124	99
P18L00782	SJS	EN	19881017	19890213	C	19881018	1
P18L00782	SJS	EN	19881017	19890213	B	19890213	119
P18L00784	SJS	EN	19881017	19890301	B	19890301	135
P18L00784	SJS	EN	19881017	19890301	2	19890125	100 -
P18L00784	SJS	EN	19881017	19890301	C	19881018	1
P18L00897	SJS	EN	19881207	19890117	A	19890117	41
P18L00897	SJS	EN	19881207	19890117	X	19881216	9 -

APPENDIX E
ACTION OFFICER CHARTS



Product Awareness Diagram

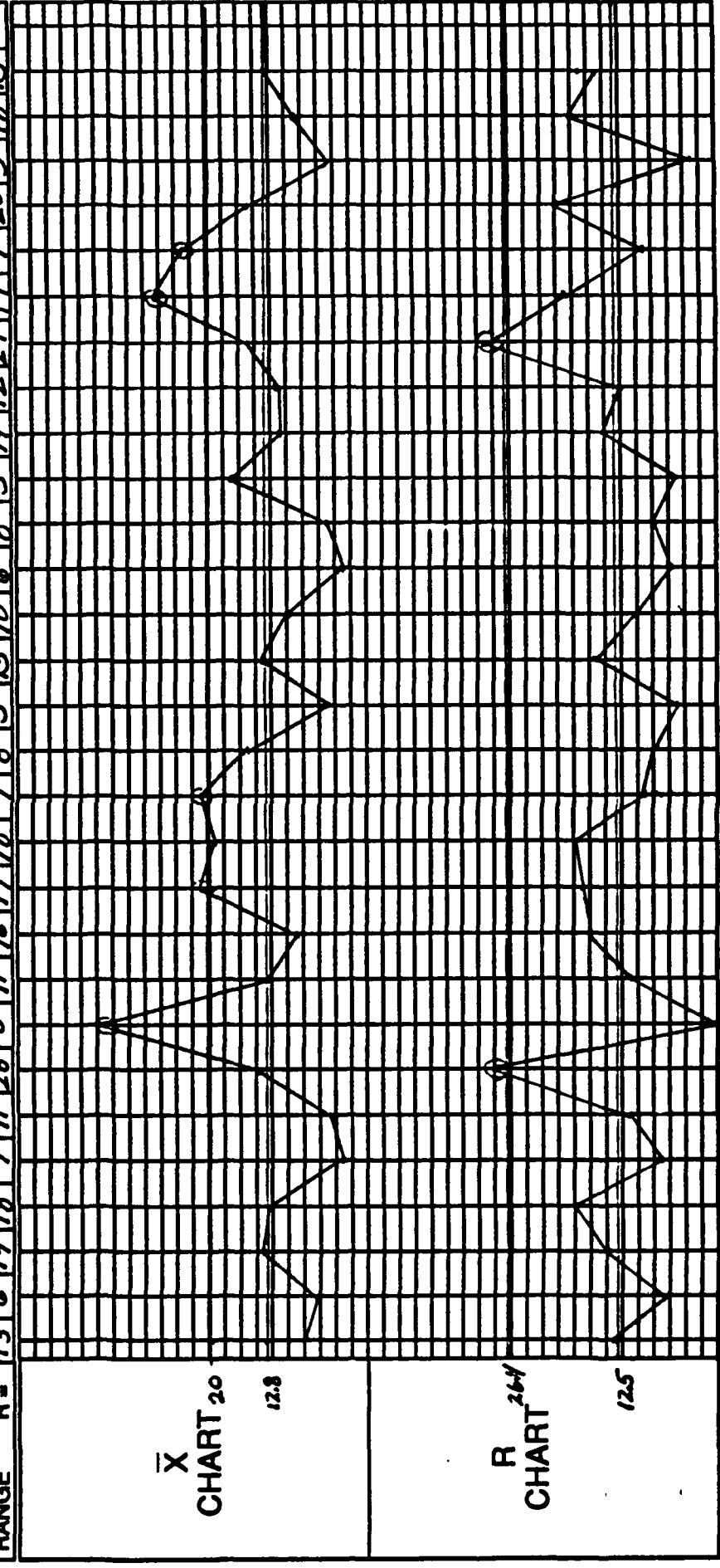
GSR / OCT 88 - 30 APR 89

$$\bar{X} = \frac{\sum X}{N} = 12.8 \quad UCL_x = \bar{X} + A_2 R = 20$$

$$R = \frac{\sum R}{N} = 12.5 \quad LCL_x = \bar{X} - A_2 R = 5.58$$

$$UCL_R = D_3 R = 26.4 \quad LCL_R = D_4 R = 0$$

DATE & TIME NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
SAMPLE READINGS	X ₁	8	8	21	8	14	7	34	12	20	10	27	18	20	6	21	14	7	9	20	17	8	12	14	7	26	6	18	8	
X ₂	15	3	8	4	6	3	6	34	9	4	17	27	18	13	6	8	14	3	4	15	14	8	0	28	25	20	6	11	21	
X ₃	6	9	14	5	1	3	22	34	11	8	10	9	25	18	6	16	9	2	8	18	10	6	14	33	25	12	4	0	21	
X ₄	9	3	22	22	1	3	0	34	20	6	13	18	25	12	1	6	1	2	3	18	3	18	18	29	21	6	3	7	6	
X ₅	2	8	14	11	1	3	34	34	11	6	27	18	20	12	5	14	9	1	1	17	8	14	29	27	6	7	3	7	6	
ΣX	40	31	66	69	12	23	70	170	63	44	102	99	106	75	24	65	50	15	25	88	52	57	73	131	114	77	22	43	62	
AV =	8	6.2	3.2	12.6	3.4	4.6	14	34	12.6	3.8	21.9	14.8	21.2	15	4.8	13	10	3	5	12.6	10.9	16.8	14.6	24.2	22.8	17.2	14.4	9.6	12.4	
HIGH X =	15	9	22	22	8	14	34	20	20	20	27	27	25	20	6	21	14	7	9	20	17	18	29	33	26	26	6	18	21	
LOW X =	2	3	8	4	1	3	6	34	9	4	10	9	18	12	1	6	4	1	1	15	3	6	0	14	17	6	3	0	6	
RANGE	R =	13	6	14	18	7	11	28	0	11	16	17	18	7	8	5	15	10	6	9	5	14	12	29	19	9	20	3	18	15

 \bar{X} CHART 20
12.8R CHART 264
12.5



Product Assurance Division

JC / OCT 88 - 30 APR 89

DATE & TIME NUMBER	TIME																														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
SAMPLE	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇	X ₈	X ₉	X ₁₀	X ₁₁	X ₁₂	X ₁₃	X ₁₄	X ₁₅	X ₁₆	X ₁₇	X ₁₈	X ₁₉	X ₂₀	X ₂₁	X ₂₂	X ₂₃	X ₂₄	X ₂₅	X ₂₆	X ₂₇	X ₂₈	X ₂₉	X ₃₀	
SAMPLE READINGS	9	25	2	37	27	4	6	6	3	21	23	37	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
X ₁	9	25	2	37	27	4	6	6	3	21	23	37	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
X ₂	27	21	52	37	22	22	6	9	2	10	145	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
X ₃	45	21	68	23	21	55	6	15	15	13	53	60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
X ₄	67	11	34	23	21	6	6	15	4	67	12	32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
X ₅	35	11	30	31	21	7	7	1	29	84	7	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ΣX	293	89	186	151	112	94	31	46	53	185	340	150	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AV =	32.6	2.9	37.2	30.2	24.9	18.9	6.2	9.2	10.6	5.9	6.8	5.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HIGH X =	45.5	25	68	37	27	55	7	15	29	84	145	60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LOW X =	9	11	2	23	21	4	6	1	2	10	7	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RANGE R =	14	66	14	14	6	51	1	14	27	74	138	57	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

 \bar{X} CHART

29

R CHART

50

LMB / OCT 88 - 30 APR 89



Product Assurance Division

		$\bar{X} = \frac{\sum X}{M} = 9.28$	$UCL_x = \bar{X} + A_2 R = 22.45$	$LCL_x = \bar{X} - A_2 R = -3.89$																									
		$R = \frac{\sum R}{M} = 22.84$	$UCL_R = D_3 R = 40.26$	$LCL_R = D_3 R = -2$																									
DATE & TIME →		1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30																											
SAMPLE	X ₁	0	2	8	2	20	15	5	1	3	29	0	3	0	7	9	37	2	28	10									
READINGS	X ₂	20	2	21	6	81	0	1	1	3	5	1	9	6	0	2	3	20	2	10									
	X ₃	6	14	5	5	5	1	2	4	3	4	1	3	7	0	7	3	68	1	8									
	X ₄	6	5	18	7	7	0	2	18	3	0	4	16	7	0	6	4	7	2	1									
	X ₅	7	7	7	20	15	2	2	11	40	0	13	16	7	9	14	22	18	27	10									
	ΣX	39	30	60	40	128	18	12	35	52	38	19	47	27	16	38	69	115	60	39									
AV =	X =	7.8	6	12	8	25.6	3.6	2.4	7	10.4	7.6	3.8	9.4	5.4	3.2	3.4	11.3	23	12	3.8									
HIGH	X =	20	14	21	20	81	15	5	18	40	29	3	16	7	9	14	37	68	28	10									
LOW	X =	0	2	5	2	5	0	1	1	3	0	0	3	0	0	2	3	2	1	1									
RANGE	R =	20	12	16	18	76	15	4	17	37	29	3	13	7	9	12	31	66	27	9									

\bar{X}
CHART
22.7

9.2

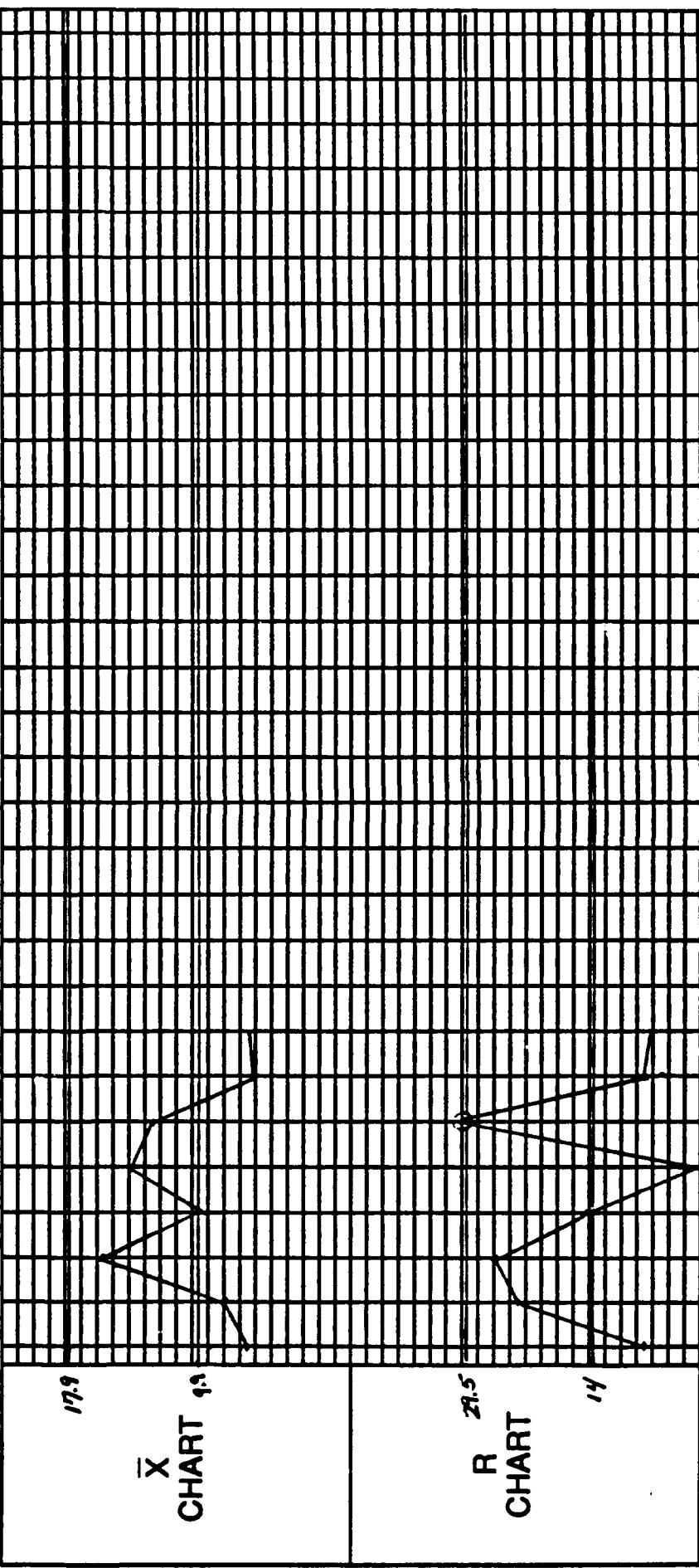
R
CHART
18.1
22.8



Product Assurance Division

SEW / Oct 88 - 30 APR 89

		$\bar{X} = \frac{\sum X}{M} = 21.9$		$UCL_x = \bar{X} + A_2 R = 17.9$		$LCL_x = \bar{X} - A_2 R = 11.8$		$UCL_R = D_4 \bar{R} = 29.59$		$LCL_R = D_3 \bar{R} = 0$																					
DATE & TIME	NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
SAMPLE	X ₁	6	5	17	11	14	14	4	3																						
READINGS	X ₂	6	7	3	20	14	1	10	9																						
X ₃	12	3	19	6	14	31	10	8																							
X ₄	5	24	29	6	14	6	3	6																							
X ₅	5	1	11	6	14	11	3	6																							
ΣX	34	40	79	49	70	63	30	32																							
AV =	X =	6.8	8	15.8	9.8	14	12.6	6.4																							
HIGH	X =	12	24	29	20	14	31	10	9																						
LOW	X =	5	1	3	6	14	1	3	3																						
RANGE	R =	7	23	26	14	0	30	7	6																						



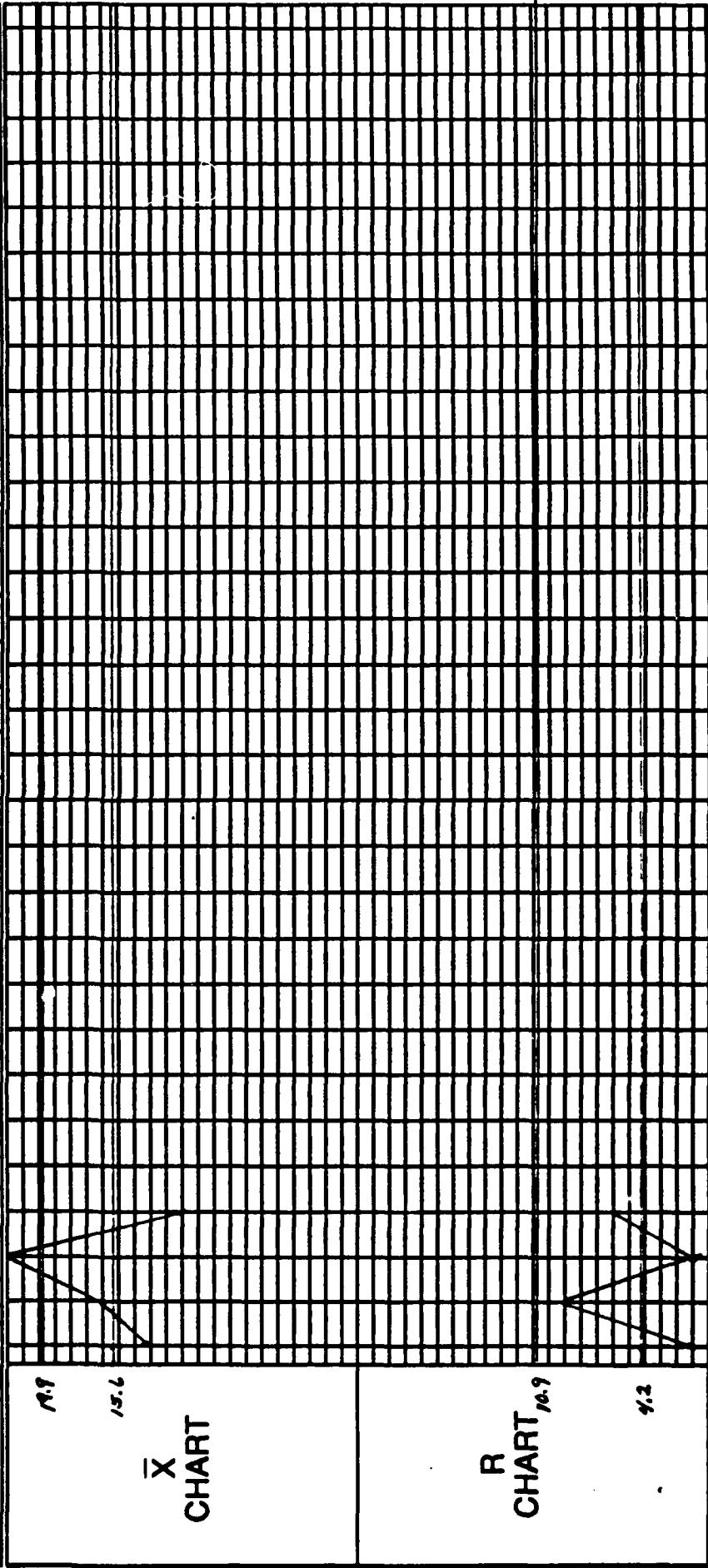


Product Assurance Division

SJS / OCT 88 - 30 APR 89

$$\bar{X} = \frac{\sum X}{M} = 15.6$$
$$UCL_x = \bar{X} + A_2 R = 19.9$$
$$LCL_x = \bar{X} - A_2 R = 11.25$$
$$\bar{R} = \frac{\sum R}{M} = 4.25$$
$$UCL_R = D_3 R = 10.9$$
$$LCL_R = D_3 R = 0$$

DATE & TIME NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
X ₁	14	13	22	15																											
X ₂	13	13	22	9																											
X ₃	13	22	22	9																											
X ₄																															
X ₅																															
ΣX	40	48	67	33																											
AV =	13.3	16	22.3	11																											
HIGH	X =	14	22	23	15																										
LOW	X =	13	22	9																											
RANGE	R =	1	9	1	6																										



APPENDIX F
PREDICTIVE ANALYSIS PLAN

HILTON SYSTEMS, INC. REPORT NO.: HSI/89-0013/0020

DEFICIENCY REPORT MANAGEMENT SYSTEM

PREDICTIVE ANALYSIS PLAN

AUGUST 1989

Prepared For:

Commander
U.S. Army Missile Command
ATTN: Mr. Thomas L. Moore
Product Assurance Directorate
AMSMI-QA-CF
Redstone Arsenal, AL 35898-5290

The Contractor, Hilton Systems, Inc., hereby certifies that, to the best of its knowledge and belief, the technical data delivered herewith under contract DAAH01-89-0013 is complete, accurate, and complies with all requirements of the contract.

PREPARED BY:

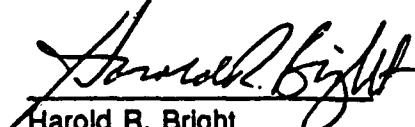

M. Wayne Miller, Jr.

CONTRACT: DAAH01-89-D-0013/0020

CLASSIFICATION AND CONTENT

DATA ITEM: N/A

APPROVED BY:


Harold R. Bright
Director, Product Assurance

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3.0 Proposed Plan	3-1
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3.2 Identify Existing Data Sources	3-1
3.3 Evaluate Existing Systems	3-2
3.4 Establish Requirements	3-2
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3.6 Develop Analysis Programs	3-3
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ABSTRACT

This report documents a proposed plan for the development of a predictive analysis capability within the MICOM Product Assurance Directorate's Customer Feedback Office. This plan is proposed by Hilton Systems Incorporated and employs a sequential methodology common to the development of a Decision Support System.

1.0 PURPOSE

The purpose of this report is to propose a plan for the development of a predictive analysis capability within the Customer Feedback Office (CFO) of the MICOM Product Assurance Directorate for government comment.

The objective of this program is to obtain failure data from as near real time data sources as possible, identify early trends and predict failures based on these trends, thereby precluding future deliveries of defective hardware to the field units.

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2.0 BACKGROUND

The 1985 Kerwin Board II report on the review of the Army Materiel Command's (AMC) product assurance program recommended that within each subordinate command AMC establish a closed loop process of data feedback and analysis, which assured timely analysis, resolution and response to the field as well as provided information and internal actions to appropriate functional organizations. This process would include Quality Deficiency Reports (QDR's), Sample Data Collection (SDC), Equipment Improvement Recommendation (EIR), demand data, initial fielding team reports and test reports.

The commander of AMC initiated the recommendation in an August 1986 directive that each major subordinate command establish a Customer Feedback Center. MICOM approved a provisional office in the Product Assurance Directorate in September 1986, followed in May 1987 with the establishment of the present Customer Feedback Office, CFO.

MICOM R 10-2 in part states that the mission of the CFO is "to provide analyses of all available data on the Deficiencies of MICOM managed equipments and to make recommendations, based on the analyses, for appropriate action." Further, function number 10 states that CFO will "perform proactive/predictive analyses of the DRS and other related data to support the materiel life cycle phases of the command's weapon systems."

3.0 PROPOSED PLAN

The sequential methodology depicted in Appendix A is proposed as the plan to accomplish the development of a computer aided predictive analysis capability within CFO. The following subparagraphs provide a description of each major element in the plan and Appendix B provides a recommended timeframe for completion of the development.

3.1 Define Goals, Objectives and Constraints

The following actions must be taken to properly define the desired system:

1. Discussions with PAD managers
2. Identify data element needs
3. Review existing functions, directives, studies, etc.
4. Define limitations of PAD hardware
5. Formulate written goals and objectives.

The discussions with the PAD managers will provide the direction and guidance needed in formulating the program goals and objectives. Such questions as: What problem are we solving and What resources are available to solve it? will be partially answered through these discussions. These discussions will also identify the data elements that the managers deem essential for their decision making process.

Review of existing functions, directives, etc., will establish a base from which to build and ensure that needed inputs and actions are not overlooked. It has been learned that experienced personnel may take undocumented and/or unconscious "short cuts" that must be captured and incorporated into the program.

The limitations of the existing PAD hardware must be determined so that such technical considerations as database size, organization, operational interface and information display are thoroughly considered. Overcoming any short falls can be accomplished through descoping the program, use of the MICOM information management directorate systems, or placing additional equipment on procurement action.

3.2 Identify Existing Data Sources

Once the data needed are agreed upon, existing army databases, programs, etc. will be evaluated to determine if a ready source exists. The aim is not to transfer all the database but to select only those data elements applicable to the MICOM requirement. The program developer must also avoid imposing additional reporting requirements on field units.

Some possible sources of data include:

1. MICOM - Provisioning Master Record
 - MLC Demand Data and Usage Data
2. MRSA - The Army Maintenance Management System Database
 - Work Order Logistics File

- 3. Precido - Central Demand Database
- 4. Logistics Center,Ft. Lee - Standard Army Maintenance System
Level 3
 - Standard Army Ammunition System
Level 1
- 5. AMC
 - Standard Depot System
 - Logistics Intelligence File
 - Commodity Command Standard System

3.3 Evaluate Existing Systems/Hardware and Software

Here again the aim is not to find a system to incorporate but to capture and implement any usable portions. Incorporation of existing code saves programming time and thus saves money in the development while delivering a system sooner.

The hardware in use with the other system must be examined to ensure software compatibility with the MICOM hardware.

There are systems available at AVSCOM and TACOM that will be evaluated with these purposes in mind. Flexibility of this software is a key element; it must be capable of being adapted to changes needed to meet the MICOM manager's needs.

Another aspect of evaluating existing systems is commercial software. If the job desired mainly extracts data from a database and produces reports based on aggregating the data, the existing query language may be all that is needed. This is based on the notion that "if I had all the relevant information in front of me and presented in an easily interpreted form, I could make a decision." Even if the reports are to be based on statistical analysis of the data rather than simple aggregations, a commercial statistics package (Minitab, SAS, SPSS, etc.) may be used along with the query language.

3.4 Establish Requirements

After all the data and information mentioned above has been collected and evaluated, the developer must again meet with the PAD managers and refine the goals and objectives into a set of system requirements.

These requirements will be used by the programmers to develop a functional description of the system and a set of program specifications. These will be presented to the government for review, comment and concurrence.

3.5 Interface Databases

The purpose of this step is to establish the method(s) needed to secure the required data elements previously identified.

This could be a simple direct download into the CFO database or so complicated as to require the development of a translation program or as time consuming as keyboard entry of hardcopy information, the latter of which is seen as totally unacceptable for the purpose proposed.

3.6 Develop Analysis Programs

The approach to be used in this step is the standard develop-use-learn-develop methodology employed in decision support system development. For this procedure the overall program is broken down into logical tasks rather than one huge effort. A portion is programmed, given to the user for hands-on evaluation, his/her comments and suggestions and/or desires are noted and incorporated to the maximum extent. This process is iterated until the desired product is achieved.

APPENDIX A PLAN OUTLINE

1. Define Goals, Objectives and Constraints
 - a. Discussions with PAD Managers
 - b. Identify Data Elements Needed
 - c. Review Existing Functions, Directives, Studies, etc.
 - d. Define Limitations of PAD Hardware
 - e. Formulate Written Goals and Objectives
2. Identify Existing Data Sources
 - a. MICOM
 - b. MRSA
 - c. Precido
 - d. Logistics Center, Ft. Lee
 - e. AMC
3. Evaluate Existing Systems/Hardware and Software
 - a. AVSCOM
 - b. TACOM
 - c. PAD; CFO, TI, RA
4. Establish Requirements
5. Interface Databases
6. Develop Analysis Programs

APPENDIX B
PREDICTIVE ANALYSIS MILESTONE CHART
MONTHS AFTER CONTRACT AWARD

